

TREATED TEXTILE ARTICLE HAVING IMPROVED MOISTURE TRANSPORT

Background of the Invention

(1) Field of the Invention

The present invention relates generally to treated textile articles and, more particularly, to a treated textile article formed from a synthetic fiber substrate and treated using a polyamide treatment agent for improved moisture transport.

(2) Description of the Prior Art

The current preference for garments made from cotton and other natural fibers is due, at least in part, to cotton's ability to wick moisture away from the body. However, cotton tends to absorb and retain moisture causing it to become less comfortable as more moisture is absorbed. Also, cotton garments tend to be slow drying. In contrast, synthetics, which tend to be hydrophobic, resist moisture transport and absorption. Thus, synthetic garments are quick drying.

The textile industry has focused efforts on developing synthetics that have the ability to effectively transport moisture away from the body while maintaining resistance to moisture absorption and quick drying characteristics. At the same time, the industry has directed research to improving synthetics' soil release, static dissipation, feel, fiber-to-fiber frictional properties, lumping of fiberfill after washing and wear life.

Some attempts have been made to modify moisture transport characteristics of a synthetic by reacting a modifying component to a synthetic polyether during initial polymerization or prior to spinning. However, this approach increases the drying time and negatively impacts numerous properties of the modified synthetic.

Other attempts have been made to modify moisture transport characteristics of a synthetic by adding a modifying component to the synthetic by melt blending. This approach relies on physical entrapment of the modifying component. However, this approach degrades physical properties and wastes the modifying component on the inside of the synthetic since its activity is required only at the surface.

Yet other attempts have been made to modify moisture transport characteristics of a synthetic by graft polymerizing a modifying component to the synthetic. However, this

approach has not been commercially successful due to the difficulties in controlling the composition of the modified synthetic, environmental, health and safety issues, long reaction times and improper process equipment. Also, the modified synthetic fails to exhibit substantial and permanent improvements. Another approach to graft
5 polymerizing has been to activate the surface of the synthetic using ionizing radiation. However, this approach requires specialized equipment and highly trained personnel, and is usually cost prohibitive.

Another approach has been made to modify moisture transport characteristics of the synthetic by the depositing of a modifying component from a bath onto the surface of
10 the synthetic. In one approach, the synthetic is subjected to heat for drying and setting the modifying component on its surface. However, some of these approaches rely on ester linkages as the connective unit and because of hydrolysis/saponification under laundering conditions result in poor durability of the treatment agent. Other approaches function for one synthetic composition but are ineffective for others.

15 Thus, there remains a need for a new and improved treated textile article formed from a synthetic fiber substrate having improved moisture transport while, at the same time, is sufficiently durable for home laundering.

Summary of the Invention

20 The present invention is directed to a treated textile article formed from a synthetic fiber substrate including a polyamide treatment agent. In the preferred embodiment, the polyamide treatment agent includes between about 19 and 95 mole percent of a hydrophobic component. In addition, the polyamide treatment agent may include effective amounts of one of an oxyalkylene derivative, an ether linkage, and an
25 oxyalkylene derivative and an ether linkage. Moreover, the polyamide treatment agent includes a hydrophilic component.

When the mole percent of a hydrophobic component of a polyamide treatment agent is between about 19 and 95, the treated textile article may have a Normalized Average Moisture Transport Durability (inch/inch) value of between about 0.1 and 1
30 when wicking is measured according to the T-PACC vertical strip wicking test where the water transported along the strip is measured at 1 minute intervals for 5 minutes with the

value at 5 minutes being reported in inches. Also, the treated textile article may have a ratio of (an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment and No Launderings) of between about 30 and 120 percent when wicking is measured according to the T-PACC vertical strip wicking test where the water transported along the strip is measured at 1 minute intervals for 5 minutes with the value at 5 minutes being reported in inches. Additionally, the treated textile article may have a ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) of between about 100 and 400 percent when wicking is measured according to the T-PACC vertical strip wicking test where the water transported along the strip is measured at 1 minute intervals for 5 minutes with the value at 5 minutes being reported in inches.

Also, when the mole percent of a hydrophobic component of a polyamide treatment agent is between about 30 and 80, the treated textile article may have a Normalized Average Moisture Transport Durability (inch/inch) value of between about 0.4 and 1. Also, the treated textile article has a ratio of (an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment and No Launderings) of between about 50 and 120 percent. Additionally, the treated textile article has a ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) of between about 220 and 400 percent

Further, when the mole percent of a hydrophobic component of a polyamide treatment agent is between about 30 and 75, the treated textile article may have a Normalized Average Moisture Transport Durability (inch/inch) value of between about 0.55 and 1. Also, the treated textile article has a ratio of (an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment and No Launderings) of between about 60 and 120 percent. Also, the treated textile article has a ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) of between about 250 and 400 percent.

The synthetic fiber substrate may be selected from any one of a polyamide, an aramid, a polyester, an acrylic, a vinyl, a polyurethane and a polyalkylene. The synthetic fiber substrate further includes a natural fiber to form a blend. The natural fiber may be selected from the group consisting of a rayon, cotton, acetate, wool, and silk.

5 The effective amount of any of an oxyalkylene derivative, an ether linkage, and an oxyalkylene derivative and an ether linkage may include an effective amount of an hydrophilic oxyalkylene derivative. When the hydrophilic oxyalkylene derivative is between about 40 and 80 weight percent of the polyamide treatment agent, the treated textile article may have a Normalized Average Moisture Transport Durability (inch/inch) 10 value of between about 0.1 and 1 when wicking is measured according to the T-PACC vertical strip wicking test where the water transported along the strip is measured at 1 minute intervals for 5 minutes with the value at 5 minutes being reported in inches. Also, the treated textile article may have a ratio of (an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment 15 and No Launderings) of between about 30 and 120 percent when wicking is measured according to the T-PACC vertical strip wicking test where the water transported along the strip is measured at 1 minute intervals for 5 minutes with the value at 5 minutes being reported in inches. Additionally, the treated textile article may have a ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport 20 With No Treatment and No Launderings) of between about 100 and 400 percent when wicking is measured according to the T-PACC vertical strip wicking test where the water transported along the strip is measured at 1 minute intervals for 5 minutes with the value at 5 minutes being reported in inches.

Also, when the hydrophilic oxyalkylene derivative is between about 46 and 80 25 weight percent of the polyamide treatment agent, the treated textile article may have a Normalized Average Moisture Transport Durability (inch/inch) value of between about 0.3 and 1. Also, the treated textile article may have a ratio of (an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment and No Launderings) of between about 30 and 100 percent.

30 Additionally, the treated textile article may have a ratio of (Average Moisture Transport

With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) of between about 200 and 400 percent

Further, when the hydrophilic oxyalkylene derivative is between about 56 and 78 weight percent of the polyamide treatment agent, the treated textile article may have a Normalized Average Moisture Transport Durability (inch/inch) value of between about 0,6 and 1. Also, the treated textile article may have a ratio of (an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment and No Launderings) of between about 30 and 80 percent. Additionally, the treated textile article may have a ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) of between about 250 and 400 percent.

In a preferred embodiment, the effective amount of any of an oxyalkylene derivative, an ether linkage, and an oxyalkylene derivative and an ether linkage is an effective amount of an oxyethylene derivative. When the oxyethylene derivative is between about 40 and 80 weight percent of the polyamide treatment agent, the treated textile article may have a Normalized Average Moisture Transport Durability (inch/inch) value of between about 0.1 and 1 when wicking is measured according to the T-PACC vertical strip wicking test where the water transported along the strip is measured at 1 minute intervals for 5 minutes with the value at 5 minutes being reported in inches. Also, the treated textile article may have a ratio of (an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment and No Launderings) of between about 30 and 120 percent. Additionally, the treated textile article may have a ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) of between about 100 and 400 percent.

Also, when the oxyethylene derivative is between about 46 and 80 weight percent of the polyamide treatment agent, the treated textile article may have a Normalized Average Moisture Transport Durability (inch/inch) value of between about 0.3 and 1 when wicking is measured according to the T-PACC vertical strip wicking test where the water transported along the strip is measured at 1 minute intervals for 5 minutes with the value at 5 minutes being reported in inches. Also the treated textile article may have a ratio of

(an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment and No Launderings) of between about 30 and 100 percent. Additionally, the treated textile article may have a ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) of between about 200 and 400 percent

Further, when the oxyethylene derivative is between about 56 and 78 weight percent of the polyamide treatment agent, the treated textile article may have a Normalized Average Moisture Transport Durability (inch/inch) value of between about .6 and 1. Also, the treated textile article may have a ratio of (an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment and No Launderings) of between about 30 and 80 percent. Additionally, the treated textile article may have a ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) of between about 250 and 400 percent.

The hydrophilic component is a reaction product of a diacid and a diamine including an effective amount of any of an oxyalkylene derivative, an ether linkage, and an oxyalkylene derivative and an ether linkage. The effective amount of any of an oxyalkylene derivative, an ether linkage, and an oxyalkylene derivative and an ether linkage may include an effective amount of a hydrophilic oxyalkylene derivative. In a preferred embodiment, the effective amount of any of an oxyalkylene derivative, an ether linkage, and an oxyalkylene derivative and an ether linkage is an effective amount of an oxyethylene derivative. The hydrophobic component is a reaction product of a diacid and a diamine.

The polyamide treatment agent may be a reaction product further including heating a mixture of any of the hydrophilic component and the hydrophobic component; a precursor of the hydrophilic component and the hydrophobic component; the hydrophilic component and a precursor of the hydrophobic component; and a precursor of the hydrophilic component and a precursor of the hydrophobic component.

The polyamide treatment agent may be a reaction product of a reaction product of diacid and diamine and a reaction product of a diacid and a diamine including an effective amount of any of an oxyalkylene derivative, ether linkage, and oxyalkylene derivative

and ether linkage. The effective amount of any of an oxyalkylene derivative, an ether linkage, and an oxyalkylene derivative and an ether linkage includes an effective amount of an hydrophilic oxyalkylene derivative, preferably an effective amount of an oxyethylene derivative.

- 5 A hydrophobic component may include a unit based on at least one of the following:

Structure I

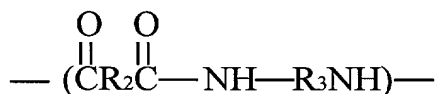


wherein

- 10 R₁ is an alkylene group with 3 to 11 carbon atoms that are any one of unsubstituted and substituted;

and

Structure II



wherein:

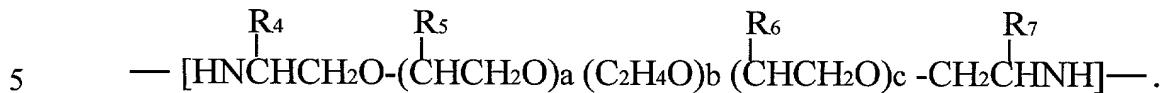
- 15 R₂ is any one of an alkylene group, a cycloalkylene group and a difunctional aromatic group with the alkylene group and the cycloalkylene of R₂ being 4 to 10 carbon atoms that are any one of unsubstituted and substituted; and

20 R₃ is any one of an alkylene group, cycloalkylene group and difunctional aromatic group with the alkylene group and the cycloalkylene of R₃ being 2 to 10 carbon atoms that are any one of unsubstituted and substituted.

- 25 The hydrophobic component may include units based on structure I, units based on structure II, and, optionally, plasticizer. On a molar percent basis between about 19 and 95, the polyamide treatment agent may be based on at least one of structure I, structure II, structure I and plasticizer, structure II and plasticizer, structure I and structure II, structure I, and structure II and plasticizer.

A hydrophilic component may include a unit based on the following:

Structure III



Wherein:

R₄ may be any one of hydrogen and an alkyl of one to four carbon atoms;

R₅ may be any one of hydrogen and an alkyl of one to four carbon atoms;

10 R₆ may be any one of hydrogen and an alkyl of one to four carbon atoms;

R₇ may be any one of hydrogen and an alkyl of one to four carbon atoms;

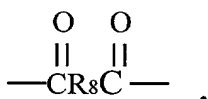
a is from 0 to 3;

b is from 1 to 78; and

c is from 0 to 3.

15 A diacid may be a unit based on the following:

Structure IV



wherein

R₈ is any one of an alkylene group, cycloalkylene group, and a difunctional aromatic group with the alkylene group and the cycloalkylene of R₈ being 4 to 10 carbon atoms that are any one of unsubstituted and substituted.

25 A plasticizer may be included in a polyamide treatment agent. A plasticizer may be derived from any one of a polyether glycol diamine having a molecular weight less than about 500 and a number of consecutive oxyethylene derivative units are less than about 4; a polyether glycol diamines having a molecular weight greater than about 500 and any one of a ratio of (oxyethylene derivative)/(oxypropylene derivative) less than
30 about 4/6, a ratio of (oxyethylene derivative)/(oxybutylene derivative) less than about 4/6,

and a sum of a ratio of (oxyethylene derivative)/(oxypropylene derivative) and a ratio of (oxyethylene derivative)/(oxybutylene derivative) less than about 4/6.

A chain terminating group may be included in a polyamide treatment agent so as to effect at least one of controlling the molecular weight of the polyamide treatment agent, changing the solubility of the polyamide treatment agent in water, and increasing a substantivity of a textile article treated with the polyamide treatment agent. The chain terminating group may be $(R_9)_d-F$, wherein R_9 is any one of a C_1-C_{24} alkyl, C_1-C_{24} aryl, C_1-C_{24} alkylaryl, C_1-C_{24} alkenyl, and an oxyalkylene derivative; d is 1-2; and F is any one of NH_2 , NH , CHO , $COCl$, and $COOR_{13}$, wherein R_{13} is any of a C_1-C_2 alkyl and hydrogen. An oxyalkylene derivative of the chain terminating group may be $R_{10}(O-CHR_{11}-CHR_{12})_p-$, wherein R_{10} is any of a C_1-C_4 alkyl; R_{11} is any of a C_1-C_4 alkyl and hydrogen; R_{12} is any of a C_1-C_4 alkyl and hydrogen; p is any value from 1 through 100. The chain terminating group may be about 1 – 7% of the treatment agent. The chain terminating group may be an alkyl, aryl and/or an alkyl aryl mono acid and/or its/their alkoxylate, an alkyl, aryl and/or alkyl aryl alcohol and/or its/their alkoxylate, and alkyl, aryl and/or alkyl aryl amine and/or its/their alkoxylates, and alkanolanine and/or polyoxyalkylene mono amine (Jeffamine XTJ-505, Jeffamine XTJ-506, Jeffamine XTJ-507 and Jeffamine XTJ-508 from Huntsman.)

A branching facilitator may be included in a polyamide treatment agent so as to induce branching of the polyamide treatment agent. The branching facilitator may be any one of a polyamine and a polyacid. The polyamine may be any one of diethylene triamine, triethylene tetraamine, tetraethylene pentamine, poly(oxy(methyl-1,2-ethanediyl), alpha-omega-(2-aminomethylethoxy-, and ether with 2-ethyl-2-(hydroxymethyl)-1,3 propanediol (3:1). (Jeffamine T-403, Jeffamine XTJ-509, and Jeffamine T-5000 from Huntsman.) A polyacid may be any one of trimellitic anhydride and citric. A branching facilitator may be between about 1% and 3% by weight of the polyamide treatment agent.

Accordingly, one aspect of the present invention is to provide a treated textile article formed from a synthetic fiber substrate. The treated textile article includes a polyamide treatment agent including a hydrophilic component and a hydrophobic component.

Another aspect of the present invention is to provide a polyamide treatment agent for use with a textile article formed from a synthetic fiber substrate. The polyamide treatment agent imparts to the textile article improved moisture transport while at the same time imparting durability of the moisture transport. The polyamide treatment agent includes a hydrophilic component, a hydrophobic component, and effective amounts of any one of an oxyalkylene derivative, an ether linkage, and an oxyalkylene derivative and an ether linkage.

Still another aspect of the present invention is to provide a treated textile article formed from a synthetic fiber substrate including a polyamide treatment agent. The polyamide treatment agent includes between about 19 and 95 mole percent of a hydrophobic component. In addition, the polyamide treatment agent includes effective amounts of any one of an oxyalkylene derivative, an ether linkage, and an oxyalkylene derivative and an ether linkage. Further, the polyamide treatment agent includes a hydrophilic component.

These and other aspects of the present invention will become apparent to those skilled in the art after a reading of the following description of the preferred embodiment when considered with the drawings.

Brief Description of the Drawings

FIGURE 1 is a graphical representation of the Normalized Average Moisture Transport Durability (inch/inch) value data of Table 2 in the form of a variogram represented by contours for a treated textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention;

FIGURE 2 is a graphical representation of the Normalized Average Moisture Transport Durability (inch/inch) value data of Table 2 in the form of a variogram represented by contours for a treated Nylon textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention;

FIGURE 3 is a graphical representation of the Normalized Average Moisture Transport Durability (inch/inch) value data of Table 2 in the form of a variogram

represented by contours for a treated polyester textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention;

FIGURE 4 is a graphical representation of the ratio of (an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment and No Launderings) data of Table 3 in the form of a variogram represented by contours for a treated textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention;

FIGURE 5 is a graphical representation of the ratio of (an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment and No Launderings) data of Table 3 in the form of a variogram represented by contours for a treated Nylon textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention;

FIGURE 6 is a graphical representation of the ratio of (an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment and No Launderings) data of Table 3 in the form of a variogram represented by contours for a treated polyester textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention;

FIGURE 7 is a graphical representation of the ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) data of Table 4 in the form of a variogram represented by contours for a treated textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention; and

FIGURE 8 is a graphical representation of the ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) data of Table 4 in the form of a variogram represented by contours for a treated Nylon textile article as a function of hydrophobic component

content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention; and

FIGURE 9 is a graphical representation of the ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) data of Table 4 in the form of a variogram represented by contours for a treated polyester textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention.

Description of the Preferred Embodiments

In the following description, like reference characters designate like or corresponding parts throughout the several views. Also in the following description, it is to be understood that such terms as "forward," "rearward," "left," "right," "upwardly," "downwardly," and the like are words of convenience and are not to be construed as limiting terms.

A treated textile article of the present invention is formed from a synthetic fiber substrate including a polyamide treatment agent having a hydrophilic component and a hydrophobic component. A textile article may include any one of a filament, a fiber, a yarn, a fabric constructed from any one of fibers or filaments, yarn, and products made using at least one of a filament, a fiber, a yarn, and a fabric. Some examples of products contemplated include cloth, an article of clothing including protective clothing, rope, cable, and mesh, carpeting, non-woven fabric, ...etc. Those skilled in the art will appreciate that there exist numerous other examples of textile articles that are within the scope of the present invention and not specifically mentioned.

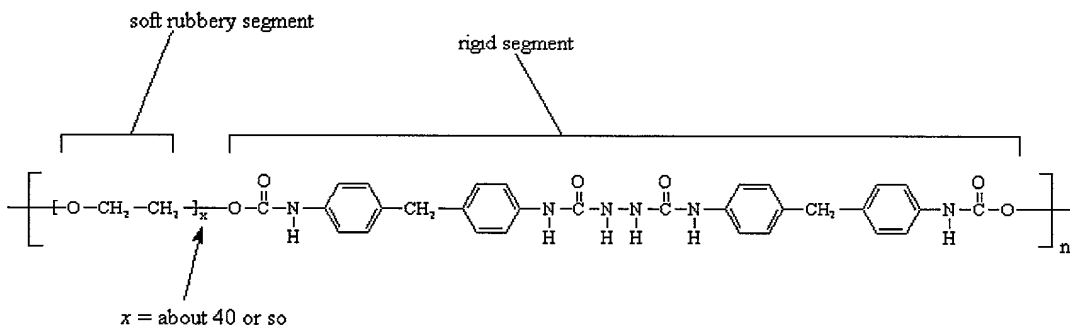
A synthetic fiber substrate may be any one of a polyamide (also known as nylon such as nylon 6,6 and nylon 6, and including aramids such as NOMEX[®] polymer and KEVLAR[®] polymer), a polyester, an acrylic, a vinyl, polyurethane including a segmented polyurethane such as LYCRA[®] polymer that is generically known as spandex, and a polyalkylene such as polypropylene.

Polyesters are any of a group of synthetic resins, such as DACRON[®] polymer or MYLAR[®] polymer, that are formed by the polycondensation of carboxylic acids with

dihydroxyl alcohols. Such resins may cure or harden, at room temperature under little or no pressure when catalyzed. Polyesters may be characterized by strength and resistance to moisture and chemicals.

Acrylics may include any of a large group of synthetic thermoplastic polymers created from various monomers (e.g., acrylic acid, methacrylic acid, esters of these acids, and acrylonitrile). These various monomers may polymerize readily when exposed to light.

Polyurethane may include a segmented polyurethane such as spandex as follows.



Spandex has a complicated structure, with both urea and urethane linkages in the backbone chain.

- 10 Spandex is a polyurethane thermoplastic elastomer, which is available from E.I. du Pont de Nemours and Company, Wilmington, DE, USA under the trade name LYCRA[®] polymer. Spandex has both urea and urethane linkages in its backbone. The special properties of spandex are due to the fact that spandex has hard and soft blocks in its repeat structure. Short polymeric chains of a polyglycol, usually about forty or so repeats
- 15 units long, are soft and rubbery. The rest of the repeat unit, the stretch with the urethane linkages, the urea linkages, and the aromatic groups, is extremely rigid. This section is stiff enough that it is believed that the rigid sections from different chains clump together and align to form fibers. Of course, they are unusual fibers, as the fibrous domains formed by the stiff blocks are linked together by the rubbery soft sections. The result is a
- 20 fiber that acts like an elastomer. This allows the making of a fabric that stretches for exercise clothing and the like. Other terms for spandex include elastic fibers and elastane fibers

Polyalkylenes may include any of a large group of synthetic thermoplastic polymers created from various monomers (e.g., ethylene, methylene, propylene, butylenes, etc.). Some alkylenes may contain at least one vinyl group. Polymers made using alkylenes containing a vinyl group are sometimes designated vinyls.

A synthetic fiber substrate may be a blend of any one of a plurality of synthetic fibers, a synthetic and a natural fiber, a plurality of synthetic fibers and a natural fiber, a synthetic and a plurality of natural fibers, and a plurality of synthetic fibers and a plurality of natural fibers. Natural fibers may include fibers derived from natural fiber and include cellulose derivatives such as rayon and acetate, cotton, wool such as from sheep, goats, llama and alpaca, and silk.

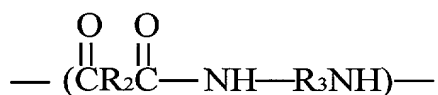
A polyamide treatment agent having a hydrophilic component and a hydrophobic component may include an effective amount of any one of oxyalkylene derivatives, ether linkages, and oxyalkylene derivatives and ether linkages (e.g., $[-C_nH_{2n}-CHR-O-]_x$), R may be any one of hydrogen and an alkyl of one to four carbon atoms. Preferably, an effective amount of any one of oxymethylene derivatives, (e.g., $[-CH_2-O-]_x$), oxyethylene derivative (e.g., $[-CH_2-CH_2-O-]_x$), ether linkages, oxymethylene derivatives and ether linkages, oxyethylene derivatives and ether linkages, oxymethylene derivatives and oxyethylenederivatives, and any combination of the three.. The hydrophobic component may be a polyamide having a unit based on at least one of the following:

Structure I



and

Structure II



R_1 may be an alkylene group with 3 to 11 carbon atoms that may be substituted or not. R_2 may be any one of an alkylene group, a cycloalkylene group and a difunctional aromatic

group. The alkylene group and the cycloalkylene of R₂ may contain 4 to 10 carbon atoms that may or may not be substituted. R₃ may be any one of an alkylene group, cycloalkylene group and difunctional aromatic group. The alkylene group and the cycloalkylene of R₃ may contain 2 to 10 carbon atoms that may or may not be substituted.

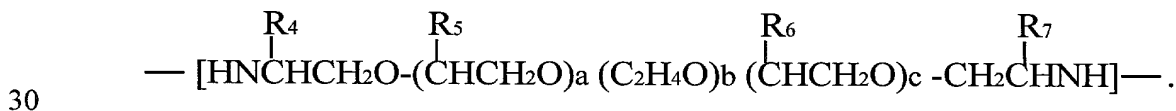
- 5 Also, a hydrophobic component may include varying amounts of both units based on structure I, units based on structure II, and, optionally, a plasticizer.

The hydrophobic component may be a reaction product of any one of a diamine and a diacid; a lactum and a diacid; a lactum, a diamine, and a diacid; and combinations thereof. Preferably, the diacid is a dicarboxylic acid. For a unit based on structure I, a
 10 lactum such as any one of Γ -butyrolactam, δ -valerolactam, ϵ -caprolactam, enantolactam, Ω -lauryllactam, and caprilactam, may be reacted and, optionally, with a dicarboxylic acid. For a unit based on structure II, an alkyl diamine may be any one of: ethylene diamine, triethylene diamine, tetramethylene diamine, hexamethylene diamine, diaminocyclohexane, 4,4'-diaminodicyclohexylene diamine, isophorone diamine, 1,3
 15 benzene diamine, 1,4 benzene diamine and 1,4-bisdiaminomethyl cyclohexane.

The hydrophilic component may be a reaction product of a diacid, preferably, a dicarboxylic acid, and a diamine. Preferably, a diamine includes a hydrophilic oxyalkylene, more preferably an oxyethylene. That is, combinations of diamines and dicarboxylic acids may be combined and reacted to create a hydrophilic component. For
 20 a unit based on structure III, a polyalkylene glycol diamine, may be reacted with a dicarboxylic acid, preferably, a dicarboxylic acid. An example of eligible polyalkylene glycol diamines according to the invention is: oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether (Jeffamine XTJ-502 from Huntsman) at molecular range of 900 to 6000 and more.

- 25 The hydrophilic component may be a polyamide having a unit based on the following:

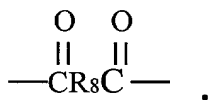
Structure III



R₄ may be any one of hydrogen and an alkyl of one to four carbon atoms. R₅ may be any one of hydrogen and an alkyl of one to four carbon atoms. R₆ may be any one of hydrogen and an alkyl of one to four carbon atoms. R₇ may be any one of hydrogen and an alkyl of one to four carbon atoms. Subscript "a" may be 0 to 3, subscript "b" may be 1 to 78 and subscript "c" may be 0-3. A polyamide unit based on structure III may or may not be connected via a diacid unit to any one of a unit based on structure I, a unit based on structure II, another unit based on structure III, and a plasticizer.

A diacid that is preferably a dicarboxylic acid unit may be based on the following:

Structure IV



R₈ may be any one of an alkylene group, cycloalkylene group, and a difunctional aromatic group. The alkylene group and the cycloalkylene of R₈ may contain 4 to 10 carbon atoms that may or may not be substituted. Both the hydrophilic component and the hydrophobic component may be a reaction product of a diacid, preferably, a dicarboxylic acid, and any one of a diamine, a lactum, and a diamine and a lactum.

In the creation of the hydrophobic component including a unit based on structure I or structure II, and the creation of a hydrophilic component including a unit based on structure III, a dicarboxylic acid of the form HOOC--R--COOH may be useful. In HOOC--R--COOH, R may be any one of an alkyl group, alkyl aryl group, aryl group and combination thereof. The alkyl group, alkyl aryl group, and aryl group may contain from 3 to 34 carbon atoms. Some specific examples of dicarboxylic acid include any one of adipic acid, pimelic acid, azelaic acid, sebacic acid, suberic, dodecanedioic acid, terephthalic acid, isophthalic acid, t-butyl isophthalic acid, dimer acids and mixtures thereof. Also, the esters and acid chlorides of these dicarboxylic acids may be used.

Unexpectedly, the polyamide treatment agent of the present invention appears to improve the surface properties of a number of synthetic substrates since it is unexpectedly a substantive agent for synthetic substrates such as any one of a polyamide (also known

as nylon and including aramids such as NOMEX[®] polymer and KEVLAR[®] polymer), a polyester, an acrylic, a vinyl and a polyalkylene such as polypropylene.

The polyamide treatment agent may be applied in simple and safe application procedures using standard textile and laundering equipment. Further, the polyamide treatment agent may be incorporated into commercial and consumer detergent and softener (e.g., either a solid or liquid) and exhausted during laundering to impart or maintain improved moisture transport while at the same time imparting durability.

Applicants believe that the chemistry of the polyamide treatment agent of the present invention allows for use in higher pH processes such as those used in industrial and institutional laundering systems as well as in home laundering applications. The product can be added separately or in a formulated detergent as either liquid or powder or in a softener formulation in an effective amount to modify properties of textile articles including imparting improved moisture transport while at the same time imparting durability. Applicants further believe that a formulation that provides between about 0.05% and about 1.5%, preferably about 0.1% – 1.0% based on the weight of the textile article to be an effective amount.

Examples of conventional methods applicable to known textile equipment include pad/heat set, foam/heat set, and exhaust. Conventional textile wet processing methods applicable to such equipment include scouring, coloration, and fabric finishing.

Potential points of application of the polyamide treatment agent in textile processing include any one of the fiber/yarn forming stage and the wet processing steps in the fabric stage. Within the fiber/yarn forming stage there are at least four points at which an effective amount of the polyamide treatment agent may be applied such as (1) to a spin finish after extrusion and before fiber drawing (e.g., the polyamide treatment agent may be applied on top of the conventional spin finish before fiber drawing); (2) to a fiber being or just drawn (e.g., the polyamide treatment agent may be applied using a metered finish applicator or a kiss roll); (3) before fiber crimping (e.g., the polyamide treatment agent may be applied by any one of a dip and nip bath, a kiss roll and a metered finish applicator then heat set onto the fiber's surface and resulting lower fiber to fiber frictional properties may improve crimping properties and yield a bulkier staple fiber); and (4) after-oiling or over-oiling (e.g., the polyamide treatment agent may be applied by passing

a warp sheet over a kiss roll just ahead of a warp beam). Applicants believe that between about 0.05% and 1.0% based on the weight of the fiber to be an effective amount.

Other potential points of application of the polyamide treatment agent in textile processing may include any one during a formation of a non-woven article (with or without adhesives), as an additive in a cleaning/scouring step, as additives in a coloration bath, during a final fabric (including non-wovens) finishing. Final fabric finishing may include any one of foaming, spraying, drawing through a dip and nip bath and drawing through a kiss roll applicator followed by heating to a sufficiently high temperature and time for heat setting (e.g., temperatures between about 200 and 350°F for between about 1 and 3 minutes).

The polyamide treatment agent also may be combined or incorporated as a portion of any one of various processing aides by formulating a chemical auxiliary for any of these textile processes. For example, a treatment agent may be combined or incorporated as a portion of any one of a softener, a heat stabilizer, antioxidants, a dyeing auxiliary, a soil repellant, a fiber spin finish, a moisture transport auxiliary, ... etc.

For example, softeners may be any of silicones, amino silicones, fatty quats, fatty amido amine, ethoxylated amines, fatty alkanolamines or alkylolamides, fatty amphoteric, ... etc. A treatment agent combined or incorporated with one or more of these softeners may improve any of a textile article's hand, hydrophilicity, and hand and hydrophilicity.

A treatment agent combined or incorporated with one or more heat stabilizers may reduce a textile article's discoloration during heat setting. Likewise, a treatment agent combined or incorporated with one or more of antioxidants may reduce a textile article's discoloration during heat setting.

For example, a soil repellant may be any of fluorocarbons, anionic polymers, ... etc. A treatment agent combined or incorporated with one or more soil repellants may act to extend the one or more soil repellants.

A treatment agent combined or incorporated with one or more dyeing auxiliaries may reduce repulsion between a textile article and the dying liquor. A treatment agent combined or incorporated with one or more fiber spin finishes may reduce fiber to fiber friction by lubrication and a treatment agent combined or incorporated with one or more

antistats may reduce fiber to fiber friction by relieving electrostatic buildup in the textile article,

Such improvements are contemplated among woven and non-woven textile articles, either with or without an adhesive. Again, applicants believe that between about 0.05% and 1.0% based on the weight of the fiber to be an effective amount of the polyamide treatment agent.

The polyamide treatment agent may impart to a number of synthetic substrates improved moisture transport while, at the same time, imparting sufficient durability for home laundering. For example, it has been found that, unexpectedly, the polyamide treatment agent of the present invention may impart improved moisture transport to synthetic substrates while at the same time the moisture transport being durable to at least five home launderings. Unexpectedly, and in addition to improved moisture transport and durability, the polyamide treatment agent may impart improved static dissipation, soil release, fiber-to-fiber friction and "hand" properties. As used herein, hand is defined as the tactile qualities of a fabric, e.g., softness, firmness, elasticity, fineness, resilience, and other qualities perceived by touch. Dictionary of Fiber & Textile Technology; Copyright 1989, 1990 Hoechst Celanese Corporation.

Various substrates were treated with a polyamide treatment agent according to embodiment of the present invention and then tested according to the following procedures to determine the performance of a treated textile article.

The as received various substrates were scoured as set forth below. Some scoured substrates were treated with a polyamide treatment agent, others were set aside for comparison.

Nylon substrates (40/12 dull nylon 6, warpknit, weight 7.6 oz./yard) were scoured using about 1g/liter ALKON® NS scouring agent (Apollo Chemical Corporation, Burlington, NC) at about 160°F for about 10 minutes. After scouring, the scoured Nylon substrates were rinsed and overflow washed for about 10 minutes. The overflow washed, rinsed and scoured Nylon substrates were dried at about 200°F for about 2 minutes.

Polyester substrates (Textile Innovators Corporation, 100% polyester, Dacron 56, heatset) were scoured using about 1g/liter POLYSCOUR LF scouring agent (Apollo Chemical Corporation, Burlington, NC) at about 105°F for about 15 minutes. After

scouring, the scoured polyester substrates were rinsed and overflow washed for about 15 minutes. The overflow washed, rinsed and scoured polyester substrates were dried at about 200°F for about 2 minutes.

NOMEX® polymer fiber substrates were scoured using about 1g/liter

- 5 POLYSCOUR LF scouring agent (Apollo Chemical Corporation, Burlington, NC) at about 105°F for about 15 minutes. After scouring, the scoured NOMEX® substrates were rinsed and overflow washed for about 15 minutes. The overflow washed, rinsed and scoured NOMEX® substrates were dried at about 200°F for about 2 minutes

- 10 Polypropylene substrates were scoured using about 1g/liter POLYSCOUR LF scouring agent (Apollo Chemical Corporation, Burlington, NC) at about 105°F for about 15 minutes. After scouring, the scoured polypropylene substrates were rinsed and overflow washed for about 15 minutes. The overflow washed, rinsed and scoured polypropylene substrates were dried at 200°F for about 2 minutes

15

Moisture Transport for Pad/Cure Fabric

“Test A” Pad/Cure:

1. Using scoured fabric, the pad bath concentration and wet pick up is set such that application level is between about 0.05% and 1.0% based on the weight of the fabric.
2. Fabric is dried and heatset at 350°F for about 100 seconds (Except polypropylene is heatset at about 240°F).
3. A control fabric was subjected to the same treatment except the pad bath contains only water.
4. Allow fabric to condition for at least about 4 hours and then cut the fabric into about 1”X 7”strips 3 courses and 3 wales for knits; 3 warps and 3 wefts for warpknits; and 3 warps and 3 fills for woven.
5. Place about 5-gram weight on one end of each strip and place about 1” of weighted end in water.
6. Measure the moisture transport distance about every minute for about 5 minutes.
7. Take remaining treated fabric subject to AATCC Test Method 130-2000 Section 8 Washing Procedure (4 consecutive home launderings) using about 100 grams of 1993 AATCC Standard Reference Detergent (American Association of Textile Chemists and Colorists, 1 Davis Drive, Research Triangle Park, NC 27709) and water at a temperature of about 110°F.
8. Run through wash cycle again but use no detergent to insure that detergent has been completely removed.
9. Dry fabric in standard home dryer and then allow to condition for at least about 4 hours.
10. Cut the fabric into about 1”X 7”strips 3 courses and 3 wales for knits; 3 warps and 3 wefts for warpknits; and 3 warps and 3 fills for woven.
11. Place an about 5 gram weight on one end of each strip and place about 1” of weighted end in water.
12. Measure the moisture transport distance about every minute for about 5 minutes.

Tests of substrates with no treatment (control) and after scouring, substrates with a treatment and no laundering, and treated and substrates with a treatment and after laundering were performed. These tests are described above and substantially correspond to the vertical strip wicking test mentioned by R.L. Barker, B.J. Scruggs, and I. Shalev, of the Center for Research on Textile Protection and Comfort, College of Textiles, North Carolina State University, Raleigh, NC in their paper entitled "Evaluating Operating Room Gowns: Comparing Comfort Of Nonwoven and Woven Materials" available in the The International Nonwovens Journal Volume 9, No. 1 (Spring, 2000) and online at http://www.inda.org/subscrip/inj00_1/p23.html. This test is accepted in the industry and further details concerning the test may be obtained from the Center for Research on Textile Protection and Comfort, College of Textiles (T-PACC), North Carolina State University, Raleigh, NC. For convenience, this vertical strip wicking test is referred to in the claims as the "T-PACC vertical strip wicking test" In the T-PACC vertical strip wicking test, one end of a fabric strip about about 25mm wide X about 170 mm long is clamped vertically with the dangling end immersed to about 3 mm in distilled water at about 21°C. The height to which the water is transported along the strip is measured at 1, 5 and 10 minute intervals and reported in centimeters (cm). Higher wicking values show greater liquid water transport ability. In the present application, the water transported along the strip was measured at a 1 minute intervals for 5 minutes with the value at 5 minutes being reported in inches.

Table 1 contains a summary of moisture transport data for various treatment agents applied to the various substrates as well as untreated substrates. These data were used to compare the effect of moisture transport and moisture transport durability of a treatment agent treated textile fabric and. A number of treatment agent compositions where prepared as described in EXAMPLE 1 through EXAMPLE 34 below. The data summarized in Tables 5 through 38 were used to determine the hydrophobic component (mole percent) and the hydrophilic oxyalkylene derivative (weight percent). The data summarized in Table 1 were used to determine **Normalized Average Moisture Transport Durability** (inch/inch) (summarized in column 6 of Table 2), the ration of (Average Moisture Transport With Treatment and After Five Launderings)/(Average Moisture Transport With Treatment and No Launderings), (summarized in column 6 of

Table 3) and the the ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) (summarized in column 6 of Table 4).

In determining the hydrophobic component (mole percent) and hydrophilic oxyalkylene derivative (weight percent applicants) also took into account the use of additives believed to act a plasticizers (**Plast**). For example, a plasticizer may be used for in making a hydrophobic component to lower the melt point and/or improve solubility with hydrophilic component during reaction. Examples of plasticizers that may be used include, but are not limited to, polyether glycol diamines having a molecular weight less than about 500 and the number of consecutive oxyethylene derivative units are less than about 4; polyether glycol diamines having a molecular weight greater than about 500 and the ratio of (oxyethylene derivative)/(oxypropylene derivative) and/or (oxyethylene derivative)/(oxybutylene derivative) less than about 4/6. An example is 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine] (Jeffamine XTJ-504 from Huntsman). Because it is believed that plasticizers may have a low moisture transport potential, plasticizers have been designated as part of the hydrophobic component. Recalling Structure I (**S-I**), Structure II (**S-II**) and Structure III (**S-III**) discussed above, the **hydrophobic component (mole percent)** becomes:

$$\frac{\text{Moles S-I Units} + \text{Moles of S-II Units} + \text{Moles of Plast Units}}{\text{Moles S-I Units} + \text{Moles of S-II Units} + \text{Moles of S-III Units} + \text{Moles of Plast Units}} \times 100$$

Taking Sample 10 of EXAMPLE: 10 as summarized in Table 14 (Note: data in Tables has been rounded) one gets:

Moles **S-I** Units = 0
 Moles **S-II** Units = 0.1422
 Moles **Plast** Units = 0.0578
 Moles **S-III** Units = 0.0916

$$\text{Hydrophobic Component} = \frac{0.1422 + .0578}{0.1422 + 0.0578 + 0.0916 + 0} \times 100 = 68.6\%$$

41180

(mole percent)

$$0.0916 + .0578 + .1422$$

Further, taking Sample 24 of EXAMPLE: 24 as summarized in Table 28 (Note: data in Tables has been rounded) one gets:

- 5 Moles **S-I** Units = .2552
 Moles **S-II** Units = 0
 Moles **Plast** Units = 0
 Moles **S-III** Units = 0.1276

10 **Hydrophobic Component** = $\frac{00.2552}{00.1276 + 0.2552} \times 100 = 66.7\%$
 (mole percent)

Again recalling Structure I (**S-I**), Structure II (**S-II**), Structure III (**S-III**), Structure IV and Structure **Plast** discussed above, the **hydrophilic component (weight percent)** becomes (Based on polyether glycol diamines having a molecular weight greater than about 500 and the number of consecutive oxyethylene derivative units greater than about 4 or polyether glycol diamines having a molecular weight is greater than about 500 and the ratio of (oxyethylene derivative)/(oxypropylene derivative) or (oxyethylene derivative)/(oxybutylene derivative) greater than about 4/6) :

20
$$\frac{\text{Mass S-III}}{\text{Mass S-I} + \text{Mass S-II} + \text{Mass S-III} + \text{Mass S-IV} + \text{Mass Plast} - \text{Mass H}_2\text{O}}$$

Taking Sample 10 of EXAMPLE: 10 as summarized in Table 14 one gets:

- 25 Mass **S-I** = _____ 0 grams
 Mass of diamine for **S-II** = _____ 23.56 (70% Active) grams
 Mass of hydrophilic diamine for **S-III** = _____ 183.16 grams
 Mass **S-IV** required for structure **S-II**, **S-III** & **Plast** = _ 41.8 grams
 Mass Plast = _____ 8.55 grams
30 *Mass **H₂O** = _____ 17.37 grams
 *Mass H₂O includes 30% from HMDA/70%

hydrophilic component = $\frac{183.16}{\text{_____}} \times 100 = 76.41\%$

(Weight percent) $23.56 + 183.16 + 41.8 + 8.55 - 17.37$

Further taking Sample 24 of EXAMPLE: 24 as summarized in Table 28 one gets:

5 Mass of **S-I** = _____ 28.84
 Mass of diamine for **S-2** = _____ 0
 Mass of hydrophilic diamine for **S-II** = _____ 255.2
 Mass of S-IV required for structure **S-III** = _____ 15.97
 Mass of **Plast** = _____ 0
 10 Mass of **H₂O** = _____ 3.94

hydrophilic component = $\frac{255.2}{28.84 + 255.2 + 15.97 - 3.94} \times 100 = 86.2\%$
(Weight percent)

15 In determining the oxyethylene derivative (weight percent) (**Wt % OED**), the amount of oxyethylene derivative (OED) within the polyamide treatment agent that is contributed by the hydrophilic component and the plasterscizers (**Plast**) is determine as follows:

20
$$\frac{(\text{Mass } \mathbf{S-III})(\% \text{OED of } \mathbf{S-III}) + (\text{Mass } \mathbf{Plast})(\% \text{OED of } \mathbf{Plast})}{\text{Mass } \mathbf{S-I} + \text{Mass } \mathbf{S-II} + \text{Mass } \mathbf{S-III} + \text{Mass } \mathbf{S-IV} + \text{Mass } \mathbf{Plast} - \text{Mass } \mathbf{H_2O}}$$

Taking Sample 10 of EXAMPLE: 10 as summarized in Table 14 one gets:

25 Mass **S-I** = _____ 0 grams
 Mass of diamine for **S-II** = _____ 23.56 grams (70% Active)
 Mass of hydrophilic diamine for **S-III** = _____ 183.16 grams
 % OED of **S-III** hydrophilic diamine = _____ 85.76%
 Mass S-IV required for structure **S-II, S-III & Plast** = _____ 41.8 grams
 30 Mass **Plast** = _____ 8.55 grams
 %OED of **Plast** = _____ 59.45%

Mass H₂O = _____ 17.37 grams

$$\text{Wt \% OED} = \frac{(183.16)(.8576) + (8.55)(.5945)}{23.56 + 183.16 + 41.8 + 8.55 - 17.37} \times 100 = 67.7\%$$

5

Further taking Sample 24 of EXAMPLE: 24 as summarized in Table 28 one gets:

Mass S-I = _____ 28.84 grams

Mass of diamine for S-II = _____ 0 grams

10 Mass of hydrophilic diamine for S-III = _____ 255.2 grams

% OED of S-III hydrophilic diamine = _____ 85.76%

Mass S-IV required for structure S-III = _____ 15.97 grams

Mass Plast = _____ 0 grams

Mass H₂O = _____ 3.94 grams

15

$$\text{Wt \% OED} = \frac{(255.2)(.8576)}{28.84 + 255.2 + 15.97 - 3.94} \times 100 = 73.93\%$$

20

In determining the hydrophilic oxyalkylene derivative (weight percent) (**Wt% HOAD**), the amount of hydrophilic oxyalkylene derivative (HOAD, e.g., oxyethylene derivatives (OED) and/or oxymethylene derivatives (OMD)) within the polyamide treatment agent that is contributed by the hydrophilic component of the polyamide treatment agent is determined as follows:

25

[**hydrophilic component (weight percent)**][% OED in hydrophilic component + % OMD in hydrophilic component]

Taking Sample 10 of EXAMPLE: 10 as summarized in Table 14 one gets:

30

hydrophilic component (weight percent) = 76.41%

% OED in hydrophilic component = 85.76%

%OMD in hydrophilic component = 0%

$$\text{Wt\% HOAD} = (76.41) (.8576) = 65.5\%$$

Further taking Sample 24 of EXAMPLE: 24 as summarized in Table 28 one gets:

5

hydrophilic component (weight percent) = 86.2%

% OED in hydrophilic component = 85.76%

% OMD in hydrophilic component = 0%

10

$$\text{Wt\% HOAD} = (86.2) (.8576) = 73.92\%$$

In determining the **Normalized Average Moisture Transport Durability** (inch/inch), the ratio of [the average of the Moisture Transport (inches) in weft , coarse or fills direction for the textile with no treatment (control) and after five home launderings and the Moisture Transport (inches) in warp or wales direction for the textile with no treatment (control) and after five home launderings, (**AMTC5HL**)] is subtracted from [the average of the Moisture Transport (inches) in weft, coarse or fill direction after five home launderings of the treated textile and the Moisture Transport (inches) in warp or wales direction after five home launderings of the treated textile (**AMTT5HL**)] to [the average of the Moisture Transport (inches) in weft, coarse or fill direction after five home launderings of the treated textile and the Moisture Transport (inches) in warp or wales direction after five home launderings of the treated textile(**AMTT5HL**)] is determine as follows:

$$\text{Normalized Average Moisture Transport Durability (inch/inch),} = \frac{(\text{AMTT5HL} - \text{AMTC5HL})}{\text{AMTT5HL}}$$

Taking treated textile article Nylon/Sample 10 as summarized in Tables 1 and 2 that is a Nylon treated with Sample 10 of EXAMPLE: 10 as summarized in Table 14 one gets:

30

Moisture Transport (inches)

Textile with no treatment (control) in warps and wales direction =	0.5
Textile with no treatment (control) in wefts, coarse, and fills direction =	0.9
Treated textile in warps and wales direction after five home launderings=	1.75
Treated textile in wefts, coarse, and fills direction after five home launderings=	1.70

5

Normalized Average Moisture =
$$\frac{[(1.75 + 1.70) - (0.5 + 0.9)]}{(1.75 + 1.70)} = 0.59$$

Transport Durability(inch/inch),

10 Further taking treated textile article Nylon/Sample 24 as summarized in Tables 1 and 2
that is a Nylon treated with Sample 24 of EXAMPLE: 24 as summarized in Table 14 one
gets:

Moisture Transport (inches)

Textile with no treatment (control) in warps and wales direction =	0.5
Textile with no treatment (control) in wefts, coarse, and fills direction =	0.9
Treated textile in warps and wales direction after five home launderings=	1.5
Treated textile in wefts, coarse, and fills direction after five home launderings=	1.97

20 **Normalized Average Moisture =**
$$\frac{[(1.5 + 1.97) - (0.5 + 0.9)]}{(1.5 + 1.97)} = 0.60$$

Transport Durability(inch/inch),

25 In determining the ratio of (an Average Moisture Transport With Treatment and
After Five Launderings)/(an Average Moisture Transport With Treatment and No
Launderings), the ratio of [the average of the Moisture Transport (inches) in weft, coarse
or fill direction after five home launderings of the treated textile and the Moisture
Transport (inches) in warp or wales direction after five home launderings of the treated
textile (AMTT5HL)] to [the average of the Moisture Transport (inches) in weft, coarse or
fill direction after no home launderings of the treated textile and the Moisture Transport
(inches) in warp or wales direction after no home launderings of the treated
30 textile(AMTT0HL)] is determined as follows:

Average Moisture Transport With Treatment and After Five Launderings =
Average Moisture Transport With Treatment and No Launderings

$$\frac{(AMTT5HL)}{(AMTT0HL)}$$

5

Taking treated textile article Nylon/Sample 10 as summarized in Tables 1 and 3 that is a Nylon treated with Sample 10 of EXAMPLE: 10 as summarized in Table 14 one gets:

Moisture Transport (inches)

- 10 Treated textile in warps and wales direction after no home launderings = 2.5
Treated textile in wefts, coarse, and fills direction after no home launderings = 2.3
Treated textile in warps and wales direction after five home launderings= 1.75
Treated textile in wefts, coarse, and fills direction after five home launderings= 1.70

- 15 **Average Moisture Transport With Treatement and After Five Launderings =**
Average Moisture Transport With Treatment and No Launderings

$$\frac{(1.75 + 1.70)}{(2.5 + 2.3)} \times 100 = 72 \%$$

- 20 Further taking treated textile article Nylon/Sample 24 as summarized in Tables 1 and 3 that is a Nylon treated with Sample 24 of EXAMPLE: 24 as summarized in Table 14 one gets:

Moisture Transport (inches)

- 25 Treated textile in warps and wales direction after no home launderings = 1.9
Treated textile in wefts, coarse, and fills direction after no home launderings = 2.78
Treated textile in warps and wales direction after five home launderings= 1.5
Treated textile in wefts, coarse, and fills direction after five home launderings= 1.97

- 30 **Average Moisture Transport With Treatment and After Five Launderings =**
Average Moisture Transport With Treatment and No Launderings

$$\frac{(1.5 + 1.97)}{(1.9 + 2.78)} \times 100 = 74 \%$$

In determining the ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings), the ratio of [the average of the Moisture Transport (inches) in weft, coarse or fill direction after no home launderings of the treated textile and the Moisture Transport (inches) in warp or wales direction after no home launderings of the treated textile(AMTT0HL)] to [the average of the Moisture Transport (inches) in weft, coarse or fill direction for the textile with no treatment (control) and after no home launderings and the Moisture Transport (inches) in warp or wales direction for the textile with no treatment (control) and after no home launderings (AMTCOHL)] is determined as follows:

$$\frac{\text{Average Moisture Transport With Treatment With No Launderings}}{\text{Average Moisture Transport With No Treatment (Control) and No Launderings}} = \frac{(AMTT0HL)}{(AMTCOHL)}$$

Taking treated textile article Nylon/Sample 10 as summarized in Tables 1 and 4 that is a Nylon treated with Sample 10 of EXAMPLE: 10 as summarized in Table 14 one gets:

Textile with no treatment (control) in warps and wales direction =	0.5
Textile with no treatment (control) in wefts, coarse, and fills direction =	0.9
Treated textile in warps and wales direction after no home launderings =	2.5
Treated textile in wefts, coarse, and fills direction after no home launderings =	2.3

$$\frac{\text{Average Moisture Transport With Treatment and No Launderings}}{\text{Average Moisture Transport With No Treatment (Control) and No Launderings}} = \frac{(2.5 + 2.3)}{(0.5 + 0.9)} \times 100 = 343 \%$$

Further taking treated textile article Nylon/Sample 24 as summarized in Tables 1 and 4 that is a Nylon treated with Sample 24 of EXAMPLE: 24 as summarized in Table 14 one gets:

Textile with no treatment (control) in warps and wales direction =	0.5
--	-----

Textile with no treatment (control) in wefts, coarse, and fills direction = 0.9

Treated textile in warps and wales direction after no home launderings = 1.9

Treated textile in wefts, coarse, and fills direction after no home launderings = 2.78

- 5 **Average Moisture Transport With Treatment and No Launderings** =
Average Moisture Transport With No Treatment (Control) and No Launderings

$$\frac{(1.9 + 2.78)}{(0.5 + 0.9)} \times 100 = 334 \%$$

Table 1: Raw Data

Treatment Agent Reference	Treated Textile Article Reference	Moisture Transport With Treatment and No Launderings (inches) warps & wales	Moisture Transport With Treatment and No Launderings (inches) wefts, coarses & fills	Moisture Transport With Treatment and After Five Home Launderings (inches) warps & wales	Moisture Transport With Treatment and After Five Home Launderings (inches) wefts, coarses & fills	OxyEthylene Derivative (weight percent)	Hydrophobic Component (mole percent)
Nylon Control	Nylon/Untreated/Scoured	0.50	0.90	0.50	0.90	0.0	0.0%
Example 1	Nylon/Sample 1	2.80	2.55	1.80	1.90	62.0	76.2%
Example 4	Nylon/Sample 4	0.9	1.1	0.8	0.8	51.4	85.7%
Example 7	Nylon/Sample 7	2.90	2.65	2.15	2.25	68.1	66.7%
Example 10	Nylon/Sample 10	2.50	2.30	1.75	1.70	67.7	68.6%
Example 11	Nylon/Sample 11	1.80	2.00	1.40	1.50	75.7	43.0%
Example 12	Nylon/Sample 12	2.25	2.10	1.65	1.45	60.3	81.0%
Example 14	Nylon/Sample 14	2.00	2.10	1.40	1.60	69.8	66.0%
Example 16	Nylon/Sample 16	2.90	2.75	2.25	1.90	63.6	74.0%
Example 17	Nylon/Sample 17	1.80	2.00	0.80	1.00	78.2	28.6%
Example 18	Nylon/Sample 18	1.80	2.00	0.80	0.90	79.5	19.0%
Polyester Control	Polyester/Untreated/Scoured	1.00	1.03	0.67	0.97	0.0	0.0%
Example 2	Polyester/Sample 2	3.97	4.25	4.25	5.00	76.4	33.3%
Example 3	Polyester/Sample 3	3.95	4.25	4.25	4.97	70.2	66.7%
Example 9	Polyester/Sample 9	3.75	4.03	4.00	4.25	68.4	66.7%
Example 19	Polyester/Sample 19	1.90	2.40	1.95	2.50	62.2	76.2%
Example 20	Polyester/Sample 20	2.40	2.50	2.45	2.50	74.5	42.9%
Example 21	Polyester/Sample 21	3.80	3.90	1.10	1.20	78.7	19.0%
Nomex/ Control	Nomex/Untreated/Scoured	1.03	1.58	2.00	2.03	0.0	-
Example 3	Nomex/Sample 3	1.15	1.58	2.10	2.42	70.2	66.7%
Example 7	Nomex/Sample 7	1.33	1.58	2.33	2.67	68.1	66.7%

Table 1: Raw Data

Treatment Agent Reference	Treated Textile Article Reference	Moisture Transport With Treatment and No Launderings (inches) warps & wales	Moisture Transport With Treatment and No Launderings (inches) wefts, coarses & fills	Moisture Transport With Treatment and After Five Home Launderings (inches) warps & wales	Moisture Transport With Treatment and After Five Home Launderings (inches) wefts, coarses & fills	OxyEthylene Derivative (weight percent)	Hydrophobic Component (mole percent)
Nylon-Lycra Control	Nylon-Lycra/Untreated Scoured	-	-	1.00	0.75	0.0	0
Example 10	Nylon-Lycra/Sample 10	-	-	1.92	1.83	67.7	68.6%
Nylon Control	Nylon/Untreated Scoured	0.50	0.90	0.50	0.90	0.0	0.0%
Example 22	Nylon/Sample 22	1.95	2.91	0.80	1.10	77.2	50.0%
Example 23	Nylon/Sample 23	1.90	2.84	1.10	1.50	75.2	60.0%
Example 24	Nylon/Sample 24	1.90	2.78	1.50	1.97	73.9	66.7%
Example 25	Nylon/Sample 25	1.97	2.28	1.20	2.03	66.9	80.0%
Example 26	Nylon/Sample 26	1.93	2.23	1.50	2.03	62.4	85.0%
Example 27	Nylon/Sample 27	1.98	2.50	1.82	2.58	54.9	90.0%
Example 28	Nylon/Sample 28	0.75	0.90	0.75	0.90	40.3	95.0%
Nylon Control	Nylon/Untreated Scoured	0.50	0.90	0.50	0.90	0.0	0.0%
Example 29	Nylon/Sample 29	1.97	2.50	1.75	1.98	68.5	61.9%
Example 30	Nylon/Sample 30	2.33	2.90	1.42	1.58	66.2	65.6%
Example 31	Nylon/Sample 31	2.20	2.70	1.51	1.53	73.4	66.7%
Example 32	Nylon/Sample 32	2.25	2.80	1.60	1.90	67.9	73.7%
Example 33	Nylon/Sample 33	1.80	2.10	1.30	1.43	69.1	73.7%
Example 34	Nylon/Sample 34	2.03	2.75	1.00	1.03	65.4	66.7%
Polyester Control	Polyester/Untreated Scoured	1.00	1.03	0.67	0.97	0.0	0.0%
Example 31	Polyester/Sample 31	3.40	3.42	1.20	1.31	73.4	66.7%
Example 32	Polyester/Sample 32	3.25	3.33	1.84	1.69	67.9	73.7%
Example 33	Polyester/Sample 33	3.10	3.12	2.06	2.19	69.1	73.7%

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Table 2: Normalized Average Moisture Transport Durability (inch/inch)

Treated Textile Article Reference	Moisture Transport With Treatment and No Launderings (inches) warps & wales	Moisture Transport With Treatment and No Launderings (inches) wefts, coarses & fills	Moisture Transport With Treatment and After Five Home Launderings (inches) warps & wales	Moisture Transport With Treatment and After Five Home Launderings (inches) wefts, coarses & fills	Normalized Average Moisture Transport Durability (inch/inch)	Oxyethylene Derivative (weight percent)	Hydrophilic OxyAlkyene Derivative (weight percent)	Hydrophobic Component (mole percent)
Nylon/Untreated Scoured	0.50	0.90	0.50	0.90	0.00	0.0	0.0%	0.0%
Nylon/Sample 1	2.80	2.55	1.80	1.90	0.62	62.0	60.7%	76.2%
Nylon/Sample 4	0.9	1.1	0.8	0.8	0.13	51.4	49.7%	85.7%
Nylon/Sample 7	2.90	2.65	2.15	2.25	0.68	68.1	67.1%	66.7%
Nylon/Sample 10	2.50	2.30	1.75	1.70	0.59	67.7	65.5%	68.6%
Nylon/Sample 11	1.80	2.00	1.40	1.50	0.52	75.7	75.0%	43.0%
Nylon/Sample 12	2.25	2.10	1.65	1.45	0.54	60.3	55.3%	81.0%
Nylon/Sample 14	2.00	2.10	1.40	1.60	0.54	69.8	66.5%	66.0%
Nylon/Sample 16	2.90	2.75	2.25	1.90	0.65	63.6	61.3%	74.0%
Nylon/Sample 17	1.80	2.00	0.80	1.00	0.24	78.2	78.2%	28.6%
Nylon/Sample 18	1.80	2.00	0.80	0.90	0.19	79.5	79.5%	19.0%
Polyester/Untreated Scoured	1.00	1.03	0.67	0.97	0.00	0.0	-	0.0%
Polyester/Sample 2	3.97	4.25	4.25	5.00	0.82	76.4	76.4%	33.3%
Polyester/Sample 3	3.95	4.25	4.25	4.97	0.82	70.2	64.5%	66.7%
Polyester/Sample 9	3.75	4.03	4.00	4.25	0.80	68.4	65.1%	66.7%
Polyester/Sample 19	1.90	2.40	1.95	2.50	0.63	62.2	58.5%	76.2%
Polyester/Sample 20	2.40	2.50	2.45	2.50	0.67	74.5	74.5%	42.9%
Polyester/Sample 21	3.80	3.90	1.10	1.20	0.29	78.7	78.7%	19.0%
Nomex/Untreated Scoured	1.03	1.58	2.00	2.03	-	0.0	-	-
Nomex/Sample 3	1.15	1.58	2.10	2.42	0.10	70.2	64.5%	66.7%
Nomex/Sample 7	1.33	1.58	2.33	2.67	0.19	68.1	67.1%	66.7%

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Table 2: Normalized Average Moisture Transport Durability (inch/inch)

Treated Textile Article Reference	Moisture Transport With Treatment and No Launderings (Inches) warps & wales	Moisture Transport With Treatment and No Launderings (Inches) wefts, coarses & fills	Moisture Transport With Treatment and After Five Home Launderings (Inches) warps & wales	Moisture Transport With Treatment and After Five Home Launderings (Inches) wefts, coarses & fills	Normalized Average Moisture Transport Durability (inch/inch)	OxyEthylene Derivative (weight percent)	Hydrophilic OxyAlkyene Derivative (weight percent)	Hydrophobic Component (mole percent)
Nylon-Lycra/Untreated Scoured	-	-	1.00	0.75	-	0.0	-	0
Nylon-Lycra/Sample 10	-	-	1.92	1.83	0.53	67.7	65.5%	68.6%
Nylon/Untreated Scoured	0.50	0.90	0.50	0.90	-	0.0	0.0%	0.0%
Nylon/Sample 22	1.95	2.91	0.80	1.10	0.28	77.2	77.2%	50.0%
Nylon/Sample 23	1.90	2.84	1.10	1.50	0.47	75.2	75.2%	60.0%
Nylon/Sample 24	1.90	2.78	1.50	1.97	0.60	73.9	73.9%	66.7%
Nylon/Sample 25	1.97	2.28	1.20	2.03	0.57	66.9	66.9%	80.0%
Nylon/Sample 26	1.93	2.23	1.50	2.03	0.61	62.4	62.4%	85.0%
Nylon/Sample 27	1.98	2.50	1.82	2.58	0.69	54.9	54.9%	90.0%
Nylon/Sample 28	0.75	0.90	0.75	0.90	0.17	40.3	40.3%	95.0%
Nylon/Untreated Scoured	0.50	0.90	0.50	0.90	-	0.0	0.0%	0.0%
Nylon/Sample 29	1.97	2.50	1.75	1.98	0.63	68.5	68.5%	61.9%
Nylon/Sample 30	2.33	2.90	1.42	1.58	0.54	66.2	66.2%	65.6%
Nylon/Sample 31	2.20	2.70	1.51	1.53	0.54	73.4	73.4%	66.7%
Nylon/Sample 32	2.25	2.80	1.60	1.90	0.61	67.9	67.9%	73.7%
Nylon/Sample 33	1.80	2.10	1.30	1.43	0.49	69.1	69.1%	73.7%
Nylon/Sample 34	2.03	2.75	1.00	1.03	0.31	65.4	65.4%	66.7%
Polyester/Untreated Scoured	1.00	1.03	0.67	0.97	-	0.0	0.0%	0.0%
Polyester/Sample 31	3.40	3.42	1.20	1.31	0.45	73.4	73.4%	66.7%
Polyester/Sample 32	3.25	3.33	1.84	1.69	0.60	67.9	67.9%	73.7%
Polyester/Sample 33	3.10	3.12	2.06	2.19	0.67	69.1	69.1%	73.7%

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FIGURE 1 is a graphical representation of the Normalized Average Moisture Transport Durability (inch/inch) data of Table 2 in the form of a variogram represented by contours for a treated textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention. The surface plot or variogram was generated using 3DField contouring surface plotting program available at any one of <https://secure.reg.net/product.asp?ID=2631>; <http://field.hypermart.net/>; and <https://www.regsoft.net/regsoft/vieworderpage.php3?productid=31517>. The 3DField contouring surface plotting program is authored by Vladimir Galouchko (e-mail: vdvgal@cityline.ru). The Block Kriging option was used to estimating the value of a block from a set of nearby sample values using kriging. Kriging is a weighted-moving-average interpolation method where the set of weights assigned to samples minimizes the estimation variance, which is computed as a function of the variogram model and locations of the samples relative to each other, and to the point or block being estimated.

FIGURE 2 is a graphical representation of the Normalized Average Moisture Transport Durability (inch/inch) data of Table 2 in the form of a variogram represented by contours for a treated Nylon textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention.

FIGURE 3 is a graphical representation of the Normalized Average Moisture Transport Durability (inch/inch) data of Table 2 in the form of a variogram represented by contours for a treated polyester textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention.

Table 3: (Average Moisture Transport With Treatment and After Five Launderings)/(Average Moisture Transport With Treatment and No Launderings)								
Treated Textile Article Reference	Moisture Transport With Treatment and No Launderings (inches) warps & wales	Moisture Transport With Treatment and No Launderings (inches) wefts, coarses & fills	Moisture Transport With Treatment and After Five Home Launderings (inches) warps & wales	Moisture Transport With Treatment and After Five Home Launderings (inches) wefts, coarses & fills	Average Moisture Transport With Five Launderings Divided By Average Moisture Transport With Treatment and No Launderings	OxyEthylene Derivative (weight percent)	Hydrophilic OxyAlkyene Derivative (weight percent)	Hydrophobic Component (mole percent)
Nylon/Untreated Scoured	0.50	0.90	0.50	0.90	100%	0.0	0.0%	0.0%
Nylon/Sample 1	2.80	2.55	1.80	1.90	69%	62.0	60.7%	76.2%
Nylon/Sample 4	0.9	1.1	0.8	0.8	80%	51.4	49.7%	85.7%
Nylon/Sample 7	2.90	2.65	2.15	2.25	79%	68.1	67.1%	66.7%
Nylon/Sample 10	2.50	2.30	1.75	1.70	72%	67.7	65.5%	68.6%
Nylon/Sample 11	1.80	2.00	1.40	1.50	76%	75.7	75.0%	43.0%
Nylon/Sample 12	2.25	2.10	1.65	1.45	71%	60.3	55.3%	81.0%
Nylon/Sample 14	2.00	2.10	1.40	1.60	73%	69.8	66.5%	66.0%
Nylon/Sample 16	2.90	2.75	2.25	1.90	73%	63.6	61.3%	74.0%
Nylon/Sample 17	1.80	2.00	0.80	1.00	47%	78.2	78.2%	28.6%
Nylon/Sample 18	1.80	2.00	0.80	0.90	45%	79.5	79.5%	19.0%
Polyester/Untreated Scoured	1.00	1.03	0.67	0.97	81%	0.0	-	0.0%
Polyester/Sample 2	3.97	4.25	4.25	5.00	113%	76.4	76.4%	33.3%
Polyester/Sample 3	3.95	4.25	4.25	4.97	112%	70.2	64.5%	66.7%
Polyester/Sample 9	3.75	4.03	4.00	4.25	106%	68.4	65.1%	66.7%
Polyester/Sample 19	1.90	2.40	1.95	2.50	103%	62.2	58.5%	76.2%
Polyester/Sample 20	2.40	2.50	2.45	2.50	101%	74.5	74.5%	42.9%
Polyester/Sample 21	3.80	3.90	1.10	1.20	30%	78.7	78.7%	19.0%
Nomex/Untreated Scoured	1.03	1.58	2.00	2.03	154%	0.0	-	-
Nomex/Sample 3	1.15	1.58	2.10	2.42	166%	70.2	64.5%	66.7%
Nomex/Sample 7	1.33	1.58	2.33	2.67	172%	68.1	67.1%	66.7%

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Table 3: (Average Moisture Transport With Treatment and After Five Launderings)/(Average Moisture Transport With Treatment and No Launderings)								
Treated Textile Article Reference	Moisture Transport With Treatment and No Launderings (inches) warps & wales	Moisture Transport With Treatment and No Launderings (inches) wefts, coarses & fills	Moisture Transport With Treatment and After Five Home Launderings (inches) warps & wales	Moisture Transport With Treatment and After Five Home Launderings (inches) wefts, coarses & fills	Average Moisture Transport With Five Launderings Divided By Average Moisture Transport With Treatment and No Launderings	OxyEthylene Derivative (weight percent)	Hydrophilic OxyAlkylene Derivative (weight percent)	Hydrophobic Component (mole percent)
Nylon-Lycra/Untreated Scoured	-	-	1.00	0.75	-	0.0	-	0
Nylon-Lycra/Sample 10	-	-	1.92	1.83	-	67.7	65.5%	68.6%
Nylon/Untreated Scoured	0.50	0.90	0.50	0.90	100%	0.0	0.0%	0.0%
Nylon/Sample 22	1.95	2.91	0.80	1.10	39%	77.2	77.2%	50.0%
Nylon/Sample 23	1.90	2.84	1.10	1.50	55%	75.2	75.2%	60.0%
Nylon/Sample 24	1.90	2.78	1.50	1.97	74%	73.9	73.9%	66.7%
Nylon/Sample 25	1.97	2.28	1.20	2.03	76%	66.9	66.9%	80.0%
Nylon/Sample 26	1.93	2.23	1.50	2.03	85%	62.4	62.4%	85.0%
Nylon/Sample 27	1.98	2.50	1.82	2.58	98%	54.9	54.9%	90.0%
Nylon/Sample 28	0.75	0.90	0.75	0.90	100%	40.3	40.3%	95.0%
Nylon/Untreated Scoured	0.50	0.90	0.50	0.90	100%	0.0	0.0%	0.0%
Nylon/Sample 29	1.97	2.50	1.75	1.98	83%	68.5	68.5%	61.9%
Nylon/Sample 30	2.33	2.90	1.42	1.58	57%	66.2	66.2%	65.6%
Nylon/Sample 31	2.20	2.70	1.51	1.53	62%	73.4	73.4%	66.7%
Nylon/Sample 32	2.25	2.80	1.60	1.90	69%	67.9	67.9%	73.7%
Nylon/Sample 33	1.80	2.10	1.30	1.43	70%	69.1	69.1%	73.7%
Nylon/Sample 34	2.03	2.75	1.00	1.03	42%	65.4	65.4%	66.7%
Polyester/Untreated Scoured	1.00	1.03	0.67	0.97	81%	0.0	0.0%	0.0%
Polyester/Sample 31	3.40	3.42	1.20	1.31	37%	73.4	73.4%	66.7%
Polyester/Sample 32	3.25	3.33	1.84	1.69	54%	67.9	67.9%	73.7%
Polyester/Sample 33	3.10	3.12	2.06	2.19	68%	69.1	69.1%	73.7%

FIGURE 4 is a graphical representation of the ratio of (an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment and No Launderings) data of Table 3 in the form of a variogram represented by contours for a treated textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention;

FIGURE 5 is a graphical representation of the ratio of (an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment and No Launderings) data of Table 3 in the form of a variogram represented by contours for a treated Nylon textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention;

FIGURE 6 is a graphical representation of the ratio of (an Average Moisture Transport With Treatment and After Five Launderings)/(an Average Moisture Transport With Treatment and No Launderings) data of Table 3 in the form of a variogram represented by contours for a treated polyester textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention;

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Table 4: (Average Moisture Transport With Treatment and No Launderings)/(Average Moisture Transport With No Treatment and No Launderings)								
Treated Textile Article Reference	Moisture Transport With Treatment and No Launderings (inches) warps & wales	Moisture Transport With Treatment and No Launderings (inches) wefts, coarses & fills	Moisture Transport With Treatment and No Launderings (inches) warps & wales	Moisture Transport With Treatment and No Launderings (inches) wefts, coarses & fills	Average Moisture Transport With Treatment and No Launderings Divided By Average Moisture Transport With No Treatment and No Launderings	OxyEthylene Derivative (weight percent)	Hydrophilic OxyAlkylene Derivative (weight percent)	Hydrophobic Component (mole percent)
Nylon/Untreated Scoured	0.50	0.90	0.50	0.90	100%	0.0	0.0%	0.0%
Nylon/Sample 1	2.80	2.55	1.80	1.90	382%	62.0	60.7%	76.2%
Nylon/Sample 4	0.9	1.1	0.8	0.8	143%	51.4	49.7%	85.7%
Nylon/Sample 7	2.90	2.65	2.15	2.25	396%	68.1	67.1%	66.7%
Nylon/Sample 10	2.50	2.30	1.75	1.70	343%	67.7	65.5%	68.6%
Nylon/Sample 11	1.80	2.00	1.40	1.50	271%	75.7	75.0%	43.0%
Nylon/Sample 12	2.25	2.10	1.65	1.45	311%	60.3	55.3%	81.0%
Nylon/Sample 14	2.00	2.10	1.40	1.60	293%	69.8	66.5%	66.0%
Nylon/Sample 16	2.90	2.75	2.25	1.90	404%	63.6	61.3%	74.0%
Nylon/Sample 17	1.80	2.00	0.80	1.00	271%	78.2	78.2%	28.6%
Nylon/Sample 18	1.80	2.00	0.80	0.90	271%	79.5	79.5%	19.0%
Polyester/Untreated Scoured	1.00	1.03	0.67	0.97	100%	0.0	-	0.0%
Polyester/Sample 2	3.97	4.25	4.25	5.00	405%	76.4	76.4%	33.3%
Polyester/Sample 3	3.95	4.25	4.25	4.97	404%	70.2	64.5%	66.7%
Polyester/Sample 9	3.75	4.03	4.00	4.25	383%	68.4	65.1%	66.7%
Polyester/Sample 19	1.90	2.40	1.95	2.50	212%	62.2	58.5%	76.2%
Polyester/Sample 20	2.40	2.50	2.45	2.50	241%	74.5	74.5%	42.9%
Polyester/Sample 21	3.80	3.90	1.10	1.20	379%	78.7	78.7%	19.0%
Nomex/Untreated Scoured	1.03	1.58	2.00	2.03	-	0.0	-	-
Nomex/Sample 3	1.15	1.58	2.10	2.42	105%	70.2	64.5%	66.7%
Nomex/Sample 7	1.33	1.58	2.33	2.67	111%	68.1	67.1%	66.7%

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Table 4: (Average Moisture Transport With Treatment and No Launderings)/(Average Moisture Transport With No Treatment and No Launderings)								
Treated Textile Article Reference	Moisture Transport With Treatment and No Launderings (inches) warts & wales	Moisture Transport With Treatment and No Launderings (inches) wefts, coarses & fills	Moisture Transport With Treatment and No Launderings (inches) warts & wales	Moisture Transport With Treatment and No Launderings (inches) wefts, coarses & fills	Average Moisture Transport With Treatment and No Launderings Divided By Average Moisture Transport With No Treatment and No Launderings	OxyEthylene Derivative (weight percent)	Hydrophilic OxyAlkyene Derivative (weight percent)	Hydrophobic Component (mole percent)
Nylon-Lycra/Untreated Scoured	-	-	1.00	0.75	-	0.0	-	0
Nylon-Lycra/Sample 10	-	-	1.92	1.83	-	67.7	65.5%	68.6%
Nylon/Untreated Scoured	0.50	0.90	0.50	0.90	100%	0.0	0.0%	0.0%
Nylon/Sample 22	1.95	2.91	0.80	1.10	347%	77.2	77.2%	50.0%
Nylon/Sample 23	1.90	2.84	1.10	1.50	339%	75.2	75.2%	60.0%
Nylon/Sample 24	1.90	2.78	1.50	1.97	334%	73.9	73.9%	66.7%
Nylon/Sample 25	1.97	2.28	1.20	2.03	304%	66.9	66.9%	80.0%
Nylon/Sample 26	1.93	2.23	1.50	2.03	297%	62.4	62.4%	85.0%
Nylon/Sample 27	1.98	2.50	1.82	2.58	320%	54.9	54.9%	90.0%
Nylon/Sample 28	0.75	0.90	0.75	0.90	118%	40.3	40.3%	95.0%
Nylon/Untreated Scoured	0.50	0.90	0.50	0.90	100%	0.0	0.0%	0.0%
Nylon/Sample 29	1.97	2.50	1.75	1.98	319%	68.5	68.5%	61.9%
Nylon/Sample 30	2.33	2.90	1.42	1.58	374%	66.2	66.2%	65.6%
Nylon/Sample 31	2.20	2.70	1.51	1.53	350%	73.4	73.4%	66.7%
Nylon/Sample 32	2.25	2.80	1.60	1.90	361%	67.9	67.9%	73.7%
Nylon/Sample 33	1.80	2.10	1.30	1.43	279%	69.1	69.1%	73.7%
Nylon/Sample 34	2.03	2.75	1.00	1.03	341%	65.4	65.4%	66.7%
Polyester/Untreated Scoured	1.00	1.03	0.67	0.97	100%	0.0	0.0%	0.0%
Polyester/Sample 31	3.40	3.42	1.20	1.31	336%	73.4	73.4%	66.7%
Polyester/Sample 32	3.25	3.33	1.84	1.69	324%	67.9	67.9%	73.7%
Polyester/Sample 33	3.10	3.12	2.06	2.19	306%	69.1	69.1%	73.7%

FIGURE 7 is a graphical representation of the ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) data of Table 4 in the form of a variogram represented by contours for a treated textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention; and

FIGURE 8 is a graphical representation of the ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) data of Table 4 in the form of a variogram represented by contours for a treated Nylon textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention; and

FIGURE 9 is a graphical representation of the ratio of (Average Moisture Transport With Treatment and No Launderings)/ (Average Moisture Transport With No Treatment and No Launderings) data of Table 4 in the form of a variogram represented by contours for a treated polyester textile article as a function of hydrophobic component content in mole percent and hydrophilic oxyalkylene derivative content in weight percent according to an embodiment of the present invention.

EXAMPLE 1

Table 5: Ingredients Used in Making Treatment Agent SAMPLE 1			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)*	116	0.28	47
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine] [£]	148	0.04	6
Hexanedioic acid*	146	0.40	59
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000 [£]	~2000	0.10	202
Sodium borohydride [±]	37.8	0.001	0.03

Note: Weight of Hexamethylene Diamine based on 70% active material

*Hexamethylenediamine/70% and Hexanedioic acid (Solutia)

£2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine] and Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether (Huntsman)

±sodium borohydride (Rohm & Haas Company; Venpure Powder)

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], and sodium borohydride in about the proportions noted in Table 5 was mixed in a reactor for about 15 minutes. Then a charge of hexanedioic acid in about the proportion noted in Table 5 was added steadily to the mixture. During the addition charge of hexanedioic acid, the combination was heated to between about 350°F and 400°F and then held at between about 350°F and 400°F for about one hour. At between about 350°F and 400°F a charge of oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 5 was slowly added. The resultant combination was heated to between about 440°F and 490°F and held at temperature for about three hours. The resultant reaction product may be retained as a flake product or dispersed as molten material in water.

EXAMPLE 2

Table 6: Ingredients Used in Making Treatment Agent SAMPLE 2			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.07	11
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.00	0.00
Benzenedicarboxylic acid [@]	166	0.19	31
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.13	261
Sodium borohydride	37.8	0.001	0.03

Note: Weight of Hexamethylene Diamine based on 70% active material
@Benzenedicarboxylic acid (Amoco TA-22)

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], and sodium borohydride in about the proportions noted in Table 6 was mixed in a reactor for about 15 minutes. Then a charge of benzenedicarboxylic acid in about the proportion noted in Table 6 was added steadily to the mixture. This combination was heated to between about 350°F and 400°F and held at between about 350°F and 400°F for about one hour. At between about 350°F and 400°F a charge of oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 6 was slowly added. Then, the resultant combination was heated to between about 460°F and 520°F and held at temperature for about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 3

Table 7: Ingredients Used in Making Treatment Agent SAMPLE 3			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.03	5
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.19	28
Benzenedicarboxylic acid	166	0.31	52
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.11	217
Sodium borohydride	37.8	0.001	0.03

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], and sodium borohydride in about the proportions noted in Table 7 was mixed in a reactor for about 15 minutes. Then a charge of benzenedicarboxylic acid in about the proportion noted in Table 7 was added steadily to the mixture. This combination was heated to between about 350°F and 400°F and held at between about 350°F and 400°F for about one hour. At between about 350°F and 400°F a charge of oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 7 was slowly added. Then, the resultant combination was heated to between about 440°F and 530°F and held at temperature for about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 4

Table 8: Ingredients Used in Making Treatment Agent SAMPLE 4			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.72	120
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.09	13
Hexanedioic acid	146	0.90	132
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.14	271
Sodium borohydride	37.8	0.001	0.05

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], and sodium borohydride in about the proportions noted in Table 8 was mixed in a reactor for about 15 minutes. Then a charge of hexanedioic acid in about the proportion noted in Table 8 was added steadily to the mixture. This combination was heated to between about 350°F and 400°F and held between at about 350°F and 400°F for about one hour. At between about 350°F and 400°F a charge of oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 8 was slowly added. Then, the resultant combination was heated to between about 440°F and 490°F and held at temperature for about three hours. The resultant reaction product may be retained as a flake product or dispersed as molten material in water.

EXAMPLE 5

Table 9: Ingredients Used in Making Treatment Agent SAMPLE 5			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.11	18
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.11	16
Benzenedicarboxylic acid	166	0.16	26
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.11	221
Sodium borohydride	37.8	0.001	0.03
Hexanedioic acid	146	0.16	23

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], and sodium borohydride in about the proportions noted in Table 9 was mixed in a reactor for about 15 minutes. Then a charge of benzenedicarboxylic acid in about the proportion noted in Table 9 was added steadily to the mixture. This combination was mixed for about 30 minutes at about 240°F, heated to between about 350°F and 400°F and held at between about 350°F and 400°F for about one hour. At between about 350°F and 400°F, a charge of oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 9 was slowly added. Then, the resultant combination was heated to between about 440°F and 490°F and held at temperature for about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 6

Table 10: Ingredients Used in Making Treatment Agent SAMPLE 6			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	1.29	214
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.21	32
Hexanedioic acid	146	2.15	314
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.75	1505
Sodium borohydride	37.8	0.005	0.20

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], sodium borohydride, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether and hexanedioic acid in about the proportions noted in Table 10 was mixed in a reactor. This combination was heated to between about 440°F and 490°F and held at temperature for about four hours. The resultant reaction product may be retained as a flake product or dispersed as molten material in water.

EXAMPLE 7

Table 11: Ingredients Used in Making Treatment Agent SAMPLE 7			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	1.29	214
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.21	32
Hexanedioic acid	146	2.15	314
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.75	1505
Sodium borohydride	37.8	0.005	0.20

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], and sodium borohydride in about the proportions noted in Table 11 was mixed in a reactor for about 15 minutes. Then a charge of hexanedioic acid in about the proportions noted in Table 11 was added steadily to the mixture. This combination was heated to between about 350°F and 400°F, held at between about 350°F and 400°F for about one hour and then heated to between about 440°F and 490°F. During the heating a charge of oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 11 was slowly added. The resultant combination was held at between about 440°F and 490°F for about three hours. The resultant reaction product may be retained as a flake product or dispersed as molten material in water.

EXAMPLE 8

Table 12: Ingredients Used in Making Treatment Agent SAMPLE 8			
Raw Materials	Molecular Weight	Moles	Pounds
Hexamethylenediamine/70% (HMDA/70%)	116	0.13	21
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.02	3
Benzenedicarboxylic acid	166	0.21	35
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.07	147
Sodium borohydride	37.8	0.001	0.02

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], and sodium borohydride in about the proportions noted in Table 12 was mixed in a reactor for about 15 minutes. Then a charge of benzenedicarboxylic acid in about the proportion noted in Table 12 was added steadily to the mixture. This combination was heated to between about 350°F and 400°F and held at between about 350°F and 400°F for about one hour. At between about 350°F and 400°F a charge of oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 12 was slowly added. Then, the resultant combination was heated to between about 490°F and 520°F and held at temperature for about three hours. The resultant reaction product may be retained as a flake product or dispersed as molten material in water.

EXAMPLE 9

Table 13: Ingredients Used in Making Treatment Agent SAMPLE 9			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.07	12
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.07	11
Benzenedicarboxylic acid	166	0.21	35
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.07	146
Sodium borohydride	37.8	0.001	0.02

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], and sodium borohydride in about the proportions noted in Table 13 was mixed in a reactor for about 15 minutes. Then a charge of benzenedicarboxylic acid in about the proportion noted in Table 13 was added steadily to the mixture. This combination was heated to between about 350°F and 400°F and held at between about 350°F and 400°F for about one hour. At between about 350°F and 400°F a charge of oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 13 was slowly added. Then, the resultant combination was heated to between about 490°F and 530°F and held at temperature for about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 10

Table 14: Ingredients Used in Making Treatment Agent SAMPLE 10			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.14	24
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.06	9
Hexanedioic acid	146	0.29	42
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.09	183
Sodium borohydride	37.8		0.25

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], and sodium borohydride in about the proportions noted in Table 14 was mixed in a reactor for about 15 minutes. Then a charge of hexanedioic acid in about the proportion noted in Table 14 was added steadily to the mixture. This combination was heated to between about 350°F and 400°F and held at between about 350°F and 400°F for about one hour. At between about 350°F and 400°F a charge of oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 13 was slowly added. Then, the resultant combination was heated to between about 440°F and 490°F and held at temperature for about three hours. The resultant reaction product may be retained as a flake product or dispersed as molten material in water.

EXAMPLE 11

Table 15: Ingredients Used in Making Treatment Agent SAMPLE 11			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine (HMDA)	116	0.12	14
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.04	6
Hexanedioic acid	146	0.37	55
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.21	426

5 A charge of hexamethylenediamine, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], and sodium borohydride in about the proportions noted in Table 15 was mixed in a reactor for about 15 minutes. Then a charge of hexanedioic acid in about the proportion noted in Table 15 was added steadily to the mixture. This combination was

10 heated to between about 350°F and 400°F and held at between about 350°F and 400°F for about one hour. At between about 350°F and 400°F a charge of oxirane, methyl-, polymer with oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 15 was slowly added. Then, the resultant combination was heated to between about 440°F and 490°F and held at temperature for about three hours.

15 The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 12

Table 16: Ingredients Used in Making Treatment Agent SAMPLE 12			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.19	32
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.13	20
Hexanedioic acid	146	0.38	56
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.08	152
Sodium borohydride	37.8	0.007	0.25

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], and sodium borohydride in about the proportions noted in Table 16 was mixed in a reactor for about 15 minutes. Then a charge of hexanedioic acid in about the proportion noted in Table 16 was added steadily to the mixture. This combination was heated to between about 350°F and 400°F and held at between about 350°F and 400°F for about one hour. At between about 350°F and 400°F a charge of oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 16 was slowly added. Then, the resultant combination was heated to between about 440°F and 490°F and held at temperature for about three hours. The resultant reaction product may be retained as a flake product or dispersed as molten material in water.

EXAMPLE 13

Table 17: Ingredients Used in Making Treatment Agent SAMPLE 13			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.32	54
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.05	7
Hexanedioic acid	146	0.49	71
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.09	185
Sodium borohydride	37.8	0.001	0.03

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], and sodium borohydride in about the proportions noted in Table 5 was mixed in a reactor for about 15 minutes. Then a charge of hexanedioic acid in about the proportion noted in Table 5 was added steadily to the mixture. This combination was then heated to between about 350°F and 400°F and held at between about 350°F and 400°F for about one hour. At between about 350°F and 400°F a charge of oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 5 was slowly added. Then, the resultant combination was heated to between about 440°F and 490°F and held at temperature for about three hours. The resultant reaction product may be retained as a flake product or dispersed as molten material in water.

EXAMPLE 14

Table 18: Ingredients Used in Making Treatment Agent SAMPLE 14			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine (HMDA)	116	0.18	21
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.18	27
Hexanedioic acid	146	0.55	80
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.19	372

A charge of hexamethylenediamine, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], and sodium borohydride in about the proportions noted in Table 18 was mixed in a reactor for about 15 minutes. Then a charge of hexanedioic acid in about the proportion noted in Table 18 was added steadily to the mixture. This combination was heated to between about 350°F and 400°F and held at between about 350°F and 400°F for about one hour. At between about 350°F and 400°F a charge of oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 18 was slowly added. Then, the resultant combination was heated to between about 440°F and 490°F and held at temperature for about three hours. The resultant reaction product may be retained as a flake product or dispersed as molten material in water.

EXAMPLE 15

Table 19: Ingredients Used in Making Treatment Agent SAMPLE 15			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	1.84	214
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.21	32
Hexanedioic acid	146	2.15	314
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.75	1505
Sodium borohydride	37.8	0.005	0.20

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], sodium borohydride, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether and hexanedioic acid in about the proportions noted in Table 19 was mixed in a reactor. This combination was heated to between about 300°F and 350°F and held at between about 300°F and 350°F for about three hours. Then, the resultant combination was heated to between about 440°F and 490°F and held at temperature for about four hours. The resultant reaction product may be retained as a flake product or dispersed as molten material in water.

EXAMPLE 16

Table 20: Ingredients Used in Making Treatment Agent SAMPLE 16			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.18	30
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.06	9
Hexanedioic acid	146	0.34	50
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.08	170
Sodium borohydride	37.8	0.005	0.20

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], sodium borohydride, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether and hexanedioic acid in about the proportions noted in Table 20 was mixed in a reactor. This combination was heated to between about 350°F and 400°F and held at between about 350°F and 400°F for about one hour. Then, the resultant combination was heated to between about 440°F and 490°F and held at temperature for about three hours. The resultant reaction product may be retained as a flake product or dispersed as molten material in water.

EXAMPLE 17

Table 21: Ingredients Used in Making Treatment Agent SAMPLE 17			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.05	9
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0	0
Hexanedioic acid	146	0.18	26
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.13	268
Sodium borohydride	37.8	0.005	0.20

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70% and sodium borohydride in about the proportions noted in Table 21 was mixed in a reactor for about 15 minutes. Then a charge of hexanedioic acid in about the proportion noted in Table 21 was added steadily to the mixture. During the addition of the charge of hexanedioic acid, the combination was heated to between about 350°F and 400°F and then held at between about 350°F and 400°F for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 21 was added slowly. The resultant combination was heated to between about 440°F and 490°F and held at temperature for about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 18

Table 22: Ingredients Used in Making Treatment Agent SAMPLE 18			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.03	5
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0	0
Hexanedioic acid	146	0.16	23
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000	~2000	0.14	273
Sodium borohydride	37.8	0.005	0.20

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70% and sodium borohydride in about the proportions noted in Table 22 was mixed in a reactor for about 15 minutes. Then a charge of hexanedioic acid in about the proportion noted in Table 22 was added steadily to the mixture. During the addition charge of hexanedioic acid, the combination was heated to between about 350°F and 400°F and then held at between about 350°F and 400°F for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 22 was added slowly. The resultant combination was heated to between about 440°F and 490°F and held at temperature for about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 19

Table 23: Ingredients Used in Making Treatment Agent SAMPLE 19			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.20	32
2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine]	148	0.12	17
Benzenedicarboxylic acid	166	0.39	65
oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.10	195
Sodium borohydride	37.8	0.008	0.30

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine], and sodium borohydride in about the proportions noted in Table 23 was mixed in a reactor for about 15 minutes. After heating to about 240°F, a charge of benzenedicarboxylic acid in about the proportion noted in Table 23 was added steadily to the mixture. The combination was heated to between about 450°F and 490°F and then held at between about 450°F and 490°F for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 23 was added slowly while continuing to hold at about 450°F and 490°F. The resultant combination was heated to between about 490°F and 540°F and held at the about 490°F and 540°F temperature for about three hours. The resultant reaction product may be retained as a flake product or dispersed in water.

EXAMPLE 20

Table 24: Ingredients Used in Making Treatment Agent SAMPLE 20			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.10	16
Benzenedicarboxylic acid	166	0.21	35
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.13	254
Sodium borohydride	37.8	0.008	0.03
Hypophosphorus acid/50%	65.99	0.005	0.30

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70% and 2,2'-[1,2 ethanediylbis (oxy)] bis [ethaneamine] in about the proportions noted in Table 24 was mixed in a reactor for about 15 minutes. A charge of sodium borohydride followed by a charge of benzenedicarboxylic acid, both in about the proportions noted in Table 24, were added steadily to the mixture. The combination was heated to between about 450°F and 490°F and then held at between the about 450°F and 490°F temperature for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 24 was added slowly while continuing to hold at at between the about 450°F and 490°F temperature. The resultant combination was heated to between about 490°F and 520°F and held at between the about 490°F and 520°F temperature for about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 21

Table 25: Ingredients Used in Making Treatment Agent SAMPLE 21			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.03	5
Benzenedicarboxylic acid	166	0.16	26
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	2000	0.14	270
Sodium borohydride	37.8	0.001	0.03
Hypophosphorus acid/50%	65.99	0.005	0.30

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, and sodium borohydride in about the proportions noted in Table 25 was mixed in a reactor for about 15 minutes. A charge of benzenedicarboxylic acid in about the proportion noted in Table 25 followed by a charge of hypophosphorus acid/50% in about the proportions noted in Table 25 was added to the mixture steadily. The combination was heated to between about 450°F and 490°F and then held at between about 450°F and 490°F for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 25 was added slowly while continuing to hold at about 450°F and 490°F. The resultant combination was heated to between about 490°F and 520°F and held at temperature for about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 22

Table 26: Ingredients Used in Making Treatment Agent SAMPLE 22			
Raw Materials	Molecular Weight	Moles	Grams
Caprolactam ^{&}	113	0.13	15
Hexanedioic acid	146	0.13	19
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.13	266
Sodium borohydride	37.8	0.001	0.03
Hypophosphorus acid/50% [#]	65.99	0.005	0.30
Distilled Water	18	0.83	15

Note: [&]Caprolactam (Honeywell)
[#]Hypophosphoric (Oxy Chemical)

A charge of caprolactam, water and sodium borohydride in about the proportions noted in Table 26 was mixed in a reactor for about 15 minutes. A charge hexanedioic acid in about the proportion noted in Table 26 followed by a charge of hypophosphorus acid/50% in about the proportion noted in Table 26 was added to the mixture steadily. The combination was heated to between about 450°F and 490°F and then held at between about 450°F and 490°F for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 26 was added slowly while continuing to hold at about 450°F and 490°F. The resultant combination was heated to between about 520°F and 540°F and held at temperature for about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 23

Table 27: Ingredients Used in Making Treatment Agent SAMPLE 23			
Raw Materials	Molecular Weight	Moles	Grams
Caprolactam	113	0.19	22
Hexanedioic acid	146	0.13	19
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.13	259
Sodium borohydride	37.8	0.001	0.03
Hypophosphorus acid/50%	65.99	0.01	1
Distilled Water	18	0.83	15

5 A charge of caprolactam, water and sodium borohydride in about the proportions noted in Table 27 was mixed in a reactor for about 15 minutes. A charge hexanedioic acid in about the proportion noted in Table 27 followed by a charge of hypophosphorus acid/50% in about the proportion noted in Table 27 was added to the mixture steadily. The combination was heated to between about 450°F and 490°F and then held at between about 450°F and 490°F temperature for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 27 was added slowly while continuing to hold at about 450°F and 490°F. The resultant combination was heated to between about 520°F and 540°F and held at temperature for about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 24

Table 28: Ingredients Used in Making Treatment Agent SAMPLE 24			
Raw Materials	Molecular Weight	Moles	Grams
Caprolactam	113	0.26	29
Hexanedioic acid	146	0.11	16
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.13	255
Sodium borohydride	38	0.001	0.03
Hypophosphorus acid/50%	65.99	0.005	0.30
Distilled Water	18	0.83	15

5 A charge of caprolactam, water and sodium borohydride in about the proportions noted in Table 28 was mixed in a reactor for about 15 minutes. A charge hexanedioic acid in about the proportion noted in Table 28 followed by a charge of hypophosphorus acid/50% in about the proportion noted in Table 28 was added to the mixture steadily. The combination was heated to between about 450°F and 490°F and then held at between
10 about 450°F and 490°F temperature for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 28 was added slowly while continuing to hold at about 450°F and 490°F. The resultant combination was heated to between about 520°F and 550°F and held at temperature for about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 25

Table 29: Ingredients Used in Making Treatment Agent SAMPLE 25			
Raw Materials	Molecular Weight	Moles	Grams
Caprolactam	113	0.47	52
Hexanedioic acid	146	0.12	17
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.12	231
Sodium borohydride	37.8	0.001	0.03
Hypophosphorus acid/50%	65.99	0.005	0.30
Distilled Water	18	0.83	15

A charge of caprolactam, water and sodium borohydride in about the proportions noted in Table 29 was mixed in a reactor for about 15 minutes. A charge hexanedioic acid in about the proportion noted in Table 29 followed by a charge of hypophosphorus acid/50% in about the proportion noted in Table 29 was added to the mixture steadily.

The combination was heated to between about 450°F and 490°F and then held at between about 450°F and 490°F temperature for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 29 was added slowly while continuing to hold at about 450°F and 490°F. The resultant combination was heated to between about 520°F and 540°F and held at temperature for about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 26

Table 30: Ingredients Used in Making Treatment Agent SAMPLE 26			
Raw Materials	Molecular Weight	Moles	Grams
Caprolactam	113	0.61	69
Hexanedioic acid	146	0.11	16
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.11	215
Sodium borohydride	37.8	0.001	0.03
Hypophosphorus acid/50%	65.99	0.01	1
Distilled Water	18	0.83	15

5

A charge of caprolactam, water and sodium borohydride in about the proportions noted in Table 30 was mixed in a reactor for about 15 minutes. A charge hexanedioic acid in about the proportion noted in Table 30 followed by a charge of hypophosphorus acid/50% in about the proportion noted in Table 30 was added to the mixture steadily.

- 10 The combination was heated to between about 450°F and 490°F and then held at between about 450°F and 490°F temperature for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 30 was added slowly while continuing to hold at about 450°F and 490°F. The resultant combination was heated to between about 520°F and 550°F and held at temperature for
- 15 about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 27

Table 31: Ingredients Used in Making Treatment Agent SAMPLE 27			
Raw Materials	Molecular Weight	Moles	Grams
Caprolactam	113	0.85	96
Hexanedioic acid	146	0.1	14
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.1	190
Sodium borohydride	37.8	0.001	0.03
Hypophosphorus acid/50%	65.99	0.005	1
Distilled Water	18	0.83	15

A charge of caprolactam, water and sodium borohydride in about the proportions noted in Table 31 was mixed in a reactor for about 15 minutes. A charge hexanedioic acid in about the proportion noted in Table 31 followed by a charge of hypophosphorus acid/50% in about the proportion noted in Table 31 was added to the mixture steadily.

The combination was heated to between about 450°F and 490°F and then held at between about 450°F and 490°F temperature for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 31 was added slowly while continuing to hold at about 450°F and 490°F. The resultant combination was heated to between about 520°F and 550°F and held at temperature for about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 28

Table 32: Ingredients Used in Making Treatment Agent SAMPLE 28			
Raw Materials	Molecular Weight	Moles	Grams
Caprolactam	113	1.33	150
Hexanedioic acid	146	0.07	10
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.07	140
Sodium borohydride	37.8	0.001	0.03
Hypophosphorus acid/50%	65.99	0.01	1
Distilled Water	18	0.83	15

A charge of caprolactam, water and sodium borohydride in about the proportions noted in Table 32 was mixed in a reactor for about 15 minutes. A charge hexanedioic acid in about the proportion noted in Table 32 followed by a charge of hypophosphorus acid/50% in about the proportion noted in Table 32 was added to the mixture steadily.

The combination was heated to between about 450°F and 490°F and then held at between about 450°F and 490°F temperature for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 32 was added slowly while continuing to hold at about 450°F and 490°F. The resultant combination was heated to between about 520°F and 550°F and held at temperature for about three hours. The resultant reaction product, when molten, is dispersed in water.

EXAMPLE 29

Table 33: Ingredients Used in Making Treatment Agent SAMPLE 29			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.20	33
Methoxypoly(oxyethylene/oxypropylene)-2-propylamine of a molecular weight of 1000,	1000	0.02	15
Hexanedioic acid	146	0.31	45
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.11	216
Sodium borohydride	37.8	0.001	.03

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of methoxypoly(oxyethylene/oxypropylene) -2-propylamine, hexamethylenediamine/70% and sodium borohydride in about the proportions noted in Table 33 was mixed in a reactor for about 15 minutes. A charge hexanedioic acid in about the proportion noted in Table 33 was added to the mixture steadily. The combination was heated to between about 350°F and 400°F and then held at between about 350°F and 400°F temperature for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 33 was added slowly while continuing to hold at about 350°F and 400°F. The resultant combination was heated to between about 440°F and 490°F and held at temperature for about three hours. The resultant reaction product may be retained as a flake product or dispersed as molten material in water.

EXAMPLE 30

Table 34: Ingredients Used in Making Treatment Agent SAMPLE 30			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.19	32
Polyoxy(methyl-1,2-ethanediyl), alpha-hydro-omega-(2-aminomethylethoxy)- ether with 2-ethyl-2-(hydroxymethyl)-1,3-propanediol (3:1)	400	0.02	9
Hexanedioic acid	146	0.32	46
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.11	223
Sodium borohydride	37.8	0.001	0.03

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of Polyoxy(methyl-1,2-ethanediyl), alpha-hydro-omega-(2-aminomethylethoxy)- ether with 2-ethyl-2-(hydroxymethyl)-1,3-propanediol (3:1), hexamethylenediamine/70% and sodium borohydride in about the proportions noted in Table 34 was mixed in a reactor for about 15 minutes. A charge hexanedioic acid in about the proportion noted in Table 34 was added to the mixture steadily. The combination was heated to between about 350°F and 400°F and then held at between about 350°F and 400°F temperature for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 34 was added slowly while continuing to hold at about 350°F and 400°F. The resultant combination was heated to between about 440°F and 490°F and held at temperature for about three hours. The resultant reaction product may be retained as a flake product or dispersed as molten material in water.

EXAMPLE 31

Table 35: Ingredients Used in Making Treatment Agent SAMPLE 31			
Raw Materials	Molecular Weight	Moles	Grams
Caprolactam	113	0.25	29
Benzenedicarboxylic acid	166	0.11	18
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.13	253
Sodium borohydride	37.8	0.001	0.03
Hypophosphorus acid/50%	65.99	0.01	1
Distilled Water	18	0.83	15

5 A charge of caprolactam, water and sodium borohydride in about the proportions noted in Table 35 was mixed in a reactor for about 15 minutes. A charge benzenedicarboxylic acid in about the proportion noted in Table 35 followed by a charge of hypophosphorus acid/50% in about the proportion noted in Table 35 was added to the mixture steadily. The combination was heated to between about 450°F and 490°F and
10 then held at between about 450°F and 490°F temperature for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 35 was added slowly while continuing to hold at about 450°F and 490°F. The resultant combination was heated to between about 520°F and 550°F and held at temperature for about three hours. The resultant reaction product, when molten, is
15 dispersed in water.

EXAMPLE 32

Table 36: Ingredients Used in Making Treatment Agent SAMPLE 32			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.09	15
Caprolactam	113	0.23	26
Benzenedicarboxylic acid	166	0.19	31
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.12	232
Sodium borohydride	37.8	0.03	0.03
Hypophosphorus acid/50%	65.99	0.01	1
Distilled Water	18	0.83	15

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of hexamethylenediamine/70%, caprolactam, water and sodium borohydride in about the proportions noted in Table 36 was mixed in a reactor for about 15 minutes. A charge benzenedicarboxylic acid in about the proportion noted in Table 36 followed by a charge of hypophosphorus acid/50% in about the proportion noted in Table 36 was added to the mixture steadily. The combination was heated to between about 450°F and 490°F and then held at between about 450°F and 490°F temperature for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 36 was added slowly while continuing to hold at about 450°F and 490°F. The resultant combination was heated to between about 490°F and 540°F and held at temperature for about three hours. The resultant reaction product may be retained as a solid product or dispersed in water.

EXAMPLE 33

Table 37: Ingredients Used in Making Treatment Agent SAMPLE 33			
Raw Materials	Molecular Weight	Moles	Grams
Ethylenediamine	60	0.1	6
Caprolactam	113	0.24	27
Benzenedicarboxylic acid	166	0.19	31
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.12	236
Sodium borohydride	37.8	0.001	0.03
Hypophosphorus acid/50%	65.99	0.01	1
Distilled Water	18	0.83	15

- 5 A charge of ethylenediamine, caprolactam, water and sodium borohydride in about the proportions noted in Table 37 was mixed in a reactor for about 15 minutes. A charge benzenedicarboxylic acid in about the proportion noted in Table 37 followed by a charge of hypophosphorus acid/50% in about the proportion noted in Table 37 was added to the mixture steadily. The combination was heated to between about 450°F and 490°F and
- 10 then held at between about 450°F and 490°F temperature for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 37 was added slowly while continuing to hold at about 450°F and 490°F. The resultant combination was heated to between about 520°F and 540°F and held at temperature for about three hours. The resultant reaction product may be retained as a
- 15 solid product or dispersed in water.

EXAMPLE 34

Table 38: Ingredients Used in Making Treatment Agent SAMPLE 34			
Raw Materials	Molecular Weight	Moles	Grams
Hexamethylenediamine/70% (HMDA/70%)	116	0.22	36
5(6) Carboxy-4-Hexyl-2-Cyclohexene-1 octanoic acid	412.5	0.03	13
Hexanedioic acid	146	0.28	41
Oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether of a molecular weight of 2000,	~2000	0.11	220
Sodium borohydride	37.8		0.03

Note: Weight of Hexamethylene Diamine based on 70% active material

A charge of Hexamethylenediamine/70% and sodium borohydride in about the proportions noted in Table 38 was mixed in a reactor for about 15 minutes. A charge 5(6) carboxy-4-Hexyl-2-Cyclohexene-1 octanoic acid in about the proportion noted in Table 38 was added to the mixture. The combination was heated to about 250°F and then held at about 250°F temperature for about one half of an hour. A charge of hexanedioic acid in about the proportion noted in Table 38 was added to the mixture steadily. The combination was heated to between about 350°F and 400°F and then held at between about 300°F and 490°F temperature for about one hour. Then, oxirane, methyl-, polymer with oxirane, bis (2-aminopropyl) ether in about the proportion noted in Table 38 was added slowly while continuing to hold at about 350°F and 400°F. The resultant combination was heated to between about 440°F and 540°F and held at temperature for about three hours. The resultant reaction product, when molten, is dispersed in water. The polyamide treatment agent having the hydrophilic component and the hydrophobic

component may be produced by any manner that results in an effective treatment. For example, the ingredients may be combined to react substantially simultaneously to generate the polyamide treatment agent having the hydrophilic component and the hydrophobic component (Process "A"). For example, in the manufacture of a desired polyamide treatment agent, precursors to the hydrophilic component and precursors to the hydrophobic component (with or without any one of catalysts, antioxidants and reducing agents) may be combined in a reactor. The combination may be heated to a temperature (e.g., between about 440°F and 560°F) that is sufficient to produce a reaction product that is a polyamide treatment agent.

At temperature, the combination may be held for a sufficient amount of time (e.g., between about one and four hours) to produce a reaction product that is a polyamide treatment agent. Also, at temperature, the combination may or may not be subjected to any one of a vacuum, an inert atmosphere, and a reactive atmosphere.

Alternatively, ingredients that are precursors to the hydrophilic component may be combined to react followed by combining the hydrophilic component with or adding ingredients that are precursors to the hydrophobic component to react to result in a polyamide treatment agent and vice versa (Process "B"). For example, in the manufacture of a desired polyamide treatment agent, precursors (with or without any one of catalysts, antioxidants and reducing agents) to one of a hydrophilic and hydrophobic component of a polyamide treatment agent may be combined in a reactor. The combination may be heated to a first temperature (e.g., between about 350°F and 420°F) that is sufficient to produce a reaction product that is one of a hydrophilic and a hydrophobic component. At the first temperature, the combination may be held for a sufficient amount of time (e.g., between about one and four hours) to produce the reaction product that is one of a hydrophilic and a hydrophobic component. Then, the reaction product (which is one of a hydrophilic and hydrophobic component) and precursors (with or without any one of catalysts, antioxidants and reducing agents) to the other of the hydrophilic and the hydrophobic components of a polyamide treatment agent may be combined.

The combination may be maintained at the first temperature or heated to a second temperature (e.g., between about 450°F and 560°F) that is sufficient to produce a reaction

product that is the other of a hydrophilic or hydrophobic component of a polyamide treatment agent. At temperature, the combination may be held for a sufficient amount of time (e.g., between about one and six hours) to produce the reaction product that is the other of a hydrophilic or hydrophobic component of a polyamide treatment agent and, thus, a polyamide treatment agent. At any one of the first temperature and the second temperature, the combination may or may not be subjected to any one of a vacuum, an inert atmosphere, and a reactive atmosphere.

Yet another approach includes combining ingredients that are precursors to a hydrophilic component and ingredients that are precursors to a hydrophobic component and reacting at a first temperature for a time to produce the hydrophilic component followed by reacting at a second temperature for a time to produce the polyamide treatment agent by producing the hydrophobic component and vice versa (Process "C"). For example, in the manufacture of a desired polyamide treatment agent, precursors to a hydrophilic component and precursors to a hydrophobic component (with or without any one of catalysts, antioxidants and reducing agents) may be combined in a reactor. The combination may be heated to a first temperature (e.g., between about 300°F and 350°F) that is sufficient to produce a reaction product that is one of a hydrophilic or hydrophobic component of a polyamide treatment agent.

At the first temperature, the combination may be held for a sufficient amount of time (e.g., between about one and two hours) to produce the reaction product that is one of a hydrophilic or hydrophobic component of a polyamide treatment agent. Then the combination may be heated to a second temperature (e.g., between about 440°F and 560°F) that is sufficient to produce a reaction product that is the other of a hydrophilic or hydrophobic component of a polyamide treatment agent. At temperature, the combination may be held for a sufficient amount of time (e.g., between about two and six hours) to produce the reaction product that is the other of a hydrophilic or hydrophobic component of a polyamide treatment agent and, thus, a polyamide treatment agent. At any one of the first temperature and the second temperature, the combination may or may not be subjected to any one of a vacuum, an inert atmosphere, and a reactive atmosphere. Those skilled in the art will appreciate that instead of altering temperature, chemistry such as pH may be altered.

Other ingredients may be used in the creation of the polyamide treatment agent of the present invention. For example, it may be desirable to reduce any sedimentation that occurs from less soluble fragments of a polyamide treatment agent by incorporating dispersing aides including surfactants, natural polymer dispersants and synthetic polymer dispersants such as hydroxyethyl cellulose, guar gum, or xanthan gum.

Also, the polyamide treatment agent may be modified slightly, by the addition of between about 1% and 7% by weight of the polyamide treatment agent of chain terminating monofunctional groups such as $(R_9)_d-F$. These monofunctional groups may control molecular weight, to change solubility or to impact substantivity. Here R_9 is any one of a C_1 - C_{24} alkyl, C_1 - C_{24} aryl, C_1 - C_{24} alkylaryl, C_1 - C_{24} alkenyl, and oxyalkylene derivative (OAD) such as $R_{10}(O-CHR_{11}-CHR_{12})_p-$. The subscript "d" = 1 or 2. The group F is any one of NH_2 , NH , $COOR_{13}$, $COCl$, and a CHO . R_{10} is any one of a C_1 - C_4 alkyl. R_{11} is any one of a C_1 - C_4 alkyl and hydrogen. R_{12} is any one of a C_1 - C_4 alkyl and hydrogen. The subscript "p" is any value from 1 through 100. R_{13} is any one of a C_1 - C_2 alkyl and hydrogen.

Alternatively, the polyamide treatment agent may be modified slightly by the addition of 1-3% of any one of polyamine such as diethylene triamine, triethylene tetraamine, tetraethylene pentamine, poly(oxy(methyl-1,2-ethanediyl), alpha-omega-(2-aminomethylethoxy-, ether with 2-ethyl-2-(hydroxymethyl)-1,3 propanediol (3:1) and a polyacid such as trimellitic anhydride or citric to create more branching in the polyamide treatment agent.

The polyamide treatment agent made by any of the above-described routes may be distributed as any of a solid and a liquid. For example, a solid may be a flaked or ground agent that may be incorporated in a powdered detergent. Also, for example, a liquid may be an agent diluted in water as a solution or dispersion that is chargeable directly into the textile equipment. Techniques that may be used for a liquid include heating to a high temperature, homogenizing and agitating by high shear.

The polyamide treatment agent having a hydrophilic component and a hydrophobic component of the present invention may be characterized by being water dispersible. It may be that a polyamide treatment agent is a substantive agent. That is, a

polyamide treatment agent may be applied by immersing a synthetic substrate in a hot solution of the polyamide treatment agent in water.

Table 39: Comparison Of Process Methods:					
Fabric: Nylon					
Sample ID	Process ID	Moisture transport Initially (inches)		Moisture transport 5 Home Launderings (inches)	
		Wales	Courses	Wales	Courses
Control		1.58	1.67	.5	.9
Nylon/Sample 6	"A"	2.42	2.88	1.03	1.03
Nylon/Sample 7	"B"	2.25	3.00	1.42	1.98
Nylon/Sample 15	"C"	2.33	2.97	1.07	1.20

Results show the impact of the various processes on moisture transport durability. The process utilized in Example 7 is the one that facilitates the formation of a blocked polyamide.

***A Modified AATCC 130-2000
EVALUATION OF SOIL RELEASE (SR) AGENT***

**Application of SR Agent
Pad & Cure or Exhaust & Cure**

Pad & Cure:

1. Insure that fabric has been scoured free of contamination. Cut fabric to desired sample size.
2. Determine % wet pick up of fabric sample:
 - a. Weigh dry fabric sample
 - b. Pad fabric sample through water in which pH has been adjusted to 5 – 6.5 with acetic acid. (This fabric sample will serve as the untreated control.)
 - c. Weigh padded fabric sample:
 - d. Calculate:

$$\% \text{ Wet Pickup} = \frac{(\text{Padded sample weight}) - (\text{Dry sample weight})}{(\text{Dry sample weight})}$$

3. Using the % wet pick up from step #2, set pad bath concentration such that the application level applied to the fabric will be approximately 0.5% (based on the weight of the fabric) of the S R Agent (100% active).

- 5
4. Adjust pH of pad bath to 5.0 – 6.5 with acetic acid.

5. Pad fabric samples through bath then dry and cure at 350 F for 100 seconds. (Except polypropylene is cured at 240 F). The untreated control is also dried and cured under same conditions as the treated fabric samples.

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Exhaust & Cure (Ahiba):

1. Insure that fabric has been scoured free of contamination. Cut fabric to desired sample size and mount onto Ahiba Fabric Holder .

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2. Set Exhaust bath concentration to be approximately 0.5% (based on the weight of the fabric) of the S R Agent (100% actives). Set one bath to have pH adjusted water only to serve as the untreated control.

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3. Adjust pH of exhaust bath to 5.0 – 6.5 with acetic acid.

4. Charge dye tubes (use stainless steel dye tubes for temperatures above 210 F) with adjusted exhaust baths and place fabric samples into bath.

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5. Set exhaust temperatures to 160 –250 F depending on fabric type and hold for 15 minutes.

6. Remove fabric samples from Ahiba and then dry and cure at 350 F for 100 seconds. (Except polypropylene is cured at 240 F).

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Performance Evaluation

1. All fabric samples are allowed to condition under room conditions for at least 4 hours.

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2. The fabric samples are cut in half with one half designated for initial Soil Release and the other half designated for durable Soil Release.

Initial Soil Release Rating:

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1. The half of the samples designated for initial Soil Release evaluation:
 - a. Draw a one inch diameter circle on each fabric sample
 - b. Place each fabric sample on clean blotter paper such that the one inch circle is directly above the blotter paper
 - c. 5 drops of 3M Stain C (Dirty Motor Oil) are applied within the circle
 - d. Glasine paper (or equivalent) is placed over the drops of dirty motor oil and a 5 lb weight is placed on the glasine paper for one minute.
 - e. After one minute the weight and glasine paper are removed and the fabric is allowed to condition for at least 10 minutes.

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2. The soiled fabric samples are placed in a standard washing machine with approximately 10 pounds of ballast then washed at 105 F using 100 grams of 1993 AATCC Standard Reference Detergent though standard washing cycle.

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3. The washed fabric samples and ballast are then placed in a standard clothes dryer and dried at normal (cotton sturdy) for 45 minutes though one standard cycle. The fabric samples are allowed to condition for one hour, but not more than four hours, and then rated for release of the oily stain against 3M Stain Release Rating Scale.

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Durable Soil Release Evaluation:

1. The half of the treated fabric designated for durable Soil Release evaluation are placed in a standard washing machine with approximately 10 pounds of ballast then washed at 105° F using 100 grams of 1993 AATCC Standard Reference Detergent through four standard washing cycles. The fifth wash is run the same, except without soap.
2. The washed fabric samples and ballast are then placed in a standard clothes dryer and dried through one standard cycle. The fabric samples are then allowed to condition for at least four hours.
3. On each washed fabric sample:
 - a. Draw a one inch diameter circle
 - b. Place each fabric sample on clean blotter paper such that the one inch circle is directly above the blotter paper
 - c. 5 drops of 3M Stain C (Dirty Motor Oil) are applied within the circle
 - d. Glasine paper (or equivalent) is placed over the drops of dirty motor oil and a 5 lb weight is placed on the glasine paper for one minute.
 - e. After one minute the weight and glasine paper are removed and the fabric is allowed to condition for at least 10 minutes.
4. The soiled fabric samples are placed in a standard washing machine with approximately 10 pounds of ballast then washed at 105° F using 100 grams of AATCC Detergent through one standard washing cycle.
5. The washed fabric samples and ballast are then placed in a standard clothes dryer and dried through one standard cycle. The fabric samples are allowed to condition for one hour, but less than four hours, and then rated for release of the oily stain against 3M Stain Rating Chart.

Table 42: Soil Release Results				
Rating Based on 3-M Stain Chart				
Sample ID	Nylon 6.6		Nylon 6	
	Initial	5 Home Launderings	Initial	5 Home Launderings
Control	5.0	6.0	5.0	6.0
Nylon/Sample 10 (0.25%)	8.0	7.0	7.0	8.0
Nylon/Sample 10 (.5%)	8.0	7.0	7.0	8.0

Rating: 1 = no oily soil release; 10 = complete soil release

5 Certain modifications and improvements will occur to those skilled in the art upon a reading of the foregoing description. By way of example, one knowledgeable in formulating different chemicals to achieve a desired performance could envision incorporating the polyamide treatment agent with anionic surfactants and/or polymers to decrease the polyamide's solubility and improve its durability, with crosslinking agents

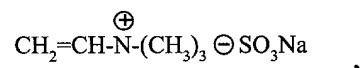
10 such as polyepoxides, polyhalogenates such as polyethylene glycol dichloride, triazine trichloride, etc., urea, formaldehyde and formaldehyde based reactives, melamines and melamine based reactives, durable press resins such as glyoxal and glyoxal based reactives, urethanes and isocyanates, etc. to improve its durability, with other hydrophilic polymers such as polyvinyl alcohols, polyacrylic acids, polyacrylates, high molecular

15 weight polyethylene glycols (molecular weights greater than 300,000), hydrophilic polyesters, hydrophilic silicones, etc. to modify the surface properties of a synthetic substrate, and with agents used to lower surface tension such as fluorocarbon surfactants and/or silicone surfactants to improve levelness of deposition of polyamide treatment agent onto a synthetic substrate's surface. One could also melt blend a more hydrophobic

20 polyamide treatment agent with a more hydrophilic polyamide treatment agent to effect the product's solubility, two polyamides treatment agents based on different chemical compositions whose composition contains two or more different synthetic substrates.

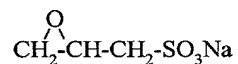
25 One knowledgeable in synthesis could envision modifications of the backbone of the polyamide treatment agent as described by reacting during synthesis of the polyamide

treatment agent a monomer containing a quaternary function such as



an alcohol, a polyoxyalkylene alcohol, a polyoxyalkylene fatty acid derivative, a diol and/or a polyoxyalkylene glycol resulting in ester linkages, an anionic diacid such as

5 sulphoisophthalic acid or its alkyl esters or an epoxy contain sulfonate such as



and/or taurine incorporating anionic character.

It should be understood that all such modifications and improvements have been deleted herein for the sake of conciseness and readability but are properly within the

10 scope of the following claims.